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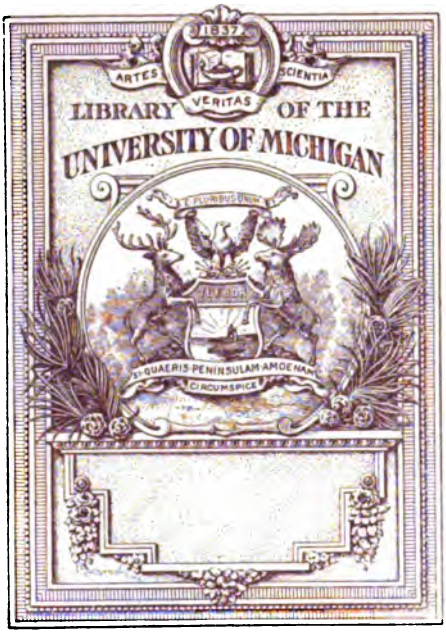
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SUPPLEMENT

TO

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JANUARY, 1907

THE

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OF

PHILADELPHIA

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1898-1902

BY COMMANDER ROBERT E. PEARY, U. S. N.

Illustrated from Photographs

JANUARY, 1904

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In the Ice-Pack.

Breaking out of Etah.

BULLETIN OF THE
Geographical Society
OF PHILADELPHIA

VOL. IV JANUARY, 1904 NO. 1

Field Work of the Peary Arctic Club.
1898-1902.

BY

COMMANDER R. E. PEARY, U. S. N.

MEMORANDUM.

The Peary Arctic Club, an unincorporated association of contributors to the expedition of 1898-1902, met for the first time at 44 Pine street, New York, January 29. 1899. and having before it Commander Peary's letters and reports from Etah, North Greenland, August 12, 1898, the date of the separation of its steamers "Hope" and "Windward," elected the following officers: President, Morris K. Jesup; Vice-President, Frederick E. Hyde; Treasurer, Henry W. Cannon; Secretary, Herbert L. Bridgman. The constitution, the first three sections of which are as follows, the others being merely of routine common to all similar bodies, was adopted:

"I. The name of the association shall be 'The Peary Arctic Club."

"II. The objects of the Club are to promote and encourage explorations of the polar regions, as set forth in Lieutenant R. E. Peary's letter to the American Geographical Society, dated January 14, 1897, and to assist him in the geography of the same; to receive and collect such objects of scientific interest, or otherwise, as may be obtainable through Lieutenant Peary's present expedition, or other expeditions of like nature; to receive, collect, and keep on file narratives and manuscripts relative to Arctic explorations; to preserve such records and keep such accounts as may be necessary for the purposes of the association; and further, to command in its work the resources of mutual acquaintance and social intercourse.

"III. Contributors to the Peary expedition of 1898 are founders of this association."

Alfred C. Harmsworth, of the London *Daily Mail*, was elected honorary member, in recognition of his service to the expedition.

The Club chartered the steamer "Diana," Captain Samuel W. Bartlett, of St. Johns, Newfoundland, and dispatched her on July 22, 1899, from Sydney, C. B., laden with ample stores and equipment. Junction with Commander Peary and the "Windward," which had wintered in Allman Bay, on the western side of Smith Sound, was effected at Etah, August 12; the "Windward" took her departure for the South, August 22, arriving at Brigus, N. F., September 13; the "Diana," having discharged her cargo at Etah, Peary's headquarters, 1899-1900, following one week later, and arriving at Sydney, C. B., September 15. The "Windward" brought the original scientific records and the personal effects of each officer and man of the Lady Franklin Bay Expedition; the sextant abandoned in 1876 by Lieutenant, now Rear-Admiral, Albert Beaumont, R. N., at Cape Britannia, Greenland, and copies of the Nares-Markham records from the Norman Lockyer and Washington Irving Island cairns, all recovered by Commander Peary in 1898 and 1899. The personal effects were subsequently distributed by the Club to the survivors and the next of kin of the deceased, and the relics of the

Royal Navy deposited through the Lords of the Admiralty in the Royal Navy Museum at Greenwich.

The "Windward," having been repaired and improved, sailed from Sydney, C. B., July 21, 1900, under Commander Samuel W. Bartlett, with Mrs. Peary and Ahnighito Peary on board, with instructions to proceed to Etah, and failing to find there Commander Peary, to cross Smith Sound to Cape Sabine, and push northward as far as might be necessary to open communication with him. The club chartered in 1901 the steamer "Erik," Captain John W. Blakeney, and dispatched her from Sydney, C. B., on July 18, with instructions to proceed to Etah, where, on August 5, junction was effected wth Commander Peary and the "Windward," which had been ice-bound in Payer Harbor during the entire winter. The "Erik" and "Windward" spent August in the north waters, the former arriving at Sydney, September 15, and the latter at Brigus, N. F., September 24. The "Erik" brought Commander Peary's report of his delineation of the northern end of Greenland in 1900, and Lockwood's original record from his cairn of 1882, at his farthest.

The Club installed new boilers and engines in the "Windward" at Newburgh, N. Y., in 1902, and on July 20 of that year she sailed a third time for the North, effecting junction with Commander Peary, August 5, at Cape Sabine, and returned with him to Sydney, C. B., September 15. He brought also from Fort Conger the library, instruments, and all the remaining equipment of the Lady Franklin Bay Expedition.

The founders of the Club were: Morris K. Jesup, Henry W. Cannon, James J. Hill, John M. Flagler, Frederick E. Hyde, E. C. Benedict, H. Hayden Sands, A. A. Raven, Henry Parish, Eben B. Thomas, James M. Constable, Herbert L. Bridgman, Henry H. Benedict, and Eliphalet W. Bliss.

Full contributing members, Edward G. Wyckoff and Clarence W. Wyckoff, of Ithaca, N. Y., and Grant B. Schley, of New York, were in 1898 elected to membership in the club, and President Charles P. Daly, of the American Geographical Society, to its executive committee, in recognition of the contribution by the Society.

REPORT ON OPERATIONS.*

It is difficult to compress the story of four years of almost continuous effort, but I shall make an effort to fix in your minds an outline, at least, of the movements and work of your expedition in the Arctic regions during the past four years.

In January, 1897, I promulgated before the American Geographical Society of New York City my plan for an extended scheme of Arctic exploration, having for its main purpose the attainment of the North Pole. During the spring of 1897, your President, Morris K. Jesup, became interested in the matter, and suggested the idea of the present Club. His example was followed by other prominent men, and late in May, through the persistent personal efforts of Chas. A. Moore, backed by letters from these and other influential men, five years' leave of absence was granted me by the Navy Department, to enable me to carry out my plans.

It being too late that season to get the main expedition under way, the summer of 1897 was devoted to a preliminary trip to the Whale Sound region, to acquaint the Eskimos with my plan for the coming year, and set them to work laying in a stock of skins and meat. These objects were successfully accomplished, and, in addition, the great "Ahnighito" meteorite of Melville Bay, the largest known meteorite in the world, was brought home.

In December, 1897, while in London, the steam yacht "Windward," which had been used in his Franz Josef Land expedition, was tendered to me by Alfred Harmsworth, who offered to have her re-engined and delivered to me in New York. This generous offer I accepted.

---

*Addressed to the Peary Arctic Club.

Cape Louis Napoleon.

Ice-Jam at Cape John Barrow.

In the spring of 1898, the Peary Arctic Club was organized, Morris K. Jesup, Henry W. Cannon, H. L. Bridgman, all personal friends of mine, forming the nucleus about which the rest assembled.

In May the "Windward" arrived, but to my extreme regret and disappointment, she still retained her antiquated and puny engine (the machinists' strike in England prevented the installation of new machinery), and was practically nothing but a sailing craft.

The lateness of the season was such that nothing could be done but make the most of the "Windward" as she was. But her extreme slowness (three and one-half knots under favorable circumstances), and the introduction of a disturbing factor, in the appropriation by another of my plan and field of work, necessitated the charter of an auxiliary ship if I did not wish to be distanced in my own domain. The "Windward" sailed from New York on the 4th of July, 1898, and on the 7th I went on board the "Hope" at Sydney, C. B., and sailed just as the first two line cablegram came of the battle of Santiago.

1898—1899.

Pushing rapidly northward, and omitting the usual calls at the Danish Greenland ports, Cape York was reached after a voyage, uneventful, except for a nip in the ice of Melville Bay, which lifted the "Hope" bodily, and for a few hours seemed to contain possibilities of trouble.

The work of hunting walrus and assembling my party of natives was commenced at once. The "Windward" soon joined us, after which the hunting was prosecuted by both ships, until the final rendezvous at Etah, whence both ships steamed out on August 13, the "Windward" to continue northward, the "Hope" bound for home. The "Windward" was four hours forcing her way through a narrow barrier of heavy ice across the mouth of Foulke Fjord. Here the "Hope" left us, straightening away southward toward Cape

Alexander, and the "Windward" headed for Cape Hawkes, showing distinctly beyond Cape Sabine.

At 4 A. M., Sunday, we encountered scattered ice off Cape Albert. About noon we were caught in the ice near Victoria Head, and drifted back several miles. Finally, we got round Victoria Head into Princess Marie Bay at 6 P. M. The bay was filled with the season's ice, not yet broken out, while Kane Basin was crowded with the heavy, moving polar pack. Between the two, extended northward across the mouth of the bay, was a series of small pools and threads of water, opening and closing with the movements of the tide. At 11.30 P. M. of the 18th, the "Windward" had worried her way across the bay to a little patch of open water close under Cape D'Urville. Here further progress was stopped by a large floe, several miles across, one end resting against the shore, and the other extending out into the heavy ice. While crossing the bay the more important stores had been stowed on the deck in readiness to be thrown out upon the ice in the event of a nip. Pending the turning of the tide, when I hoped the big floe would move and let us proceed, I landed at Cape D'Urville, deposited a small cache of supplies, and climbed the bluffs to look at the conditions northward.

August 21, I went on a reconnoissance along the ice-foot to the head of Allman Bay and into the valley beyond. The night of the 21st, young ice formed, which did not melt again. On the 28th I attempted to sledge over the sea ice to Norman Lockyer Island, but found too many weak places, and fell back on the ice-foot. The night of the 29th, the temperature fell to 13° F., and on the 31st the new ice was four and a quarter inches thick. On this day I went to Cape Hawkes and climbed to its summit, whence I could see lakes out in Kane Basin, but between them and the "Windward" the ice was closely packed—a discouraging outlook. Only a strong and continued westerly wind would give me any chance.

The uncertainty of these two weeks was very annoying to me. Had I been sure that we could not get away from here, I could have been making an inland trip. As it was, I could not leave the ship for fear an opportunity to advance would occur in my absence.

September 2d, I started on a sledge trip up Princess Marie Bay. At Cape Harrison the strong tidal current kept the ice broken, so I could not round it, and the ice foot was impracticable for sledges. I went on foot to the entrance of Cope's Bay, surveying the shore to that point, then returned to the ship after four days' absence. During this trip I obtained the English record from the cairn on the summit of Norman Lockyer Island, deposited there twenty-two years ago. This record was as fresh as when left.

September 6th, I left the ship to reconnoitre Dobbin Bay, the head of which is uncharted, returning three days later. During this trip the first real snowstorm of the season occurred, five and a half inches falling.

September 12th, one-third of my provisions, an ample year's supply for the entire party, was landed at Cape D'Urville, my Eskimos sledging loads of 700 to 1,000 pounds over the young ice. The night of the 13th, the temperature dropped to —10° F., and all hope of further advance was at an end. September 15, the boiler was blown off and preparations for winter commenced.

On the 17th, I broached my plans for the winter campaign as follows:

The autumn work was simple enough and outlined itself. It comprised two items,—the securing of a winter's supply of fresh meat for the party, and the survey of the Buchanan Strait, Hayes Sound, Princess Marie Bay region. In spite of the peculiarly desolate character of that part of the Grinnell Land coast immediately about the "Windward," and the apparent utter absence of animal life, I felt confident of accomplishing the former. Various reconnoissances thus far on the north shore of Princess Marie Bay had given me little encouragement, but I knew that the Eskimos had killed one or two musk-oxen in years past on Bache Island, and that region looked favorable for them. As regards the survey, a presentiment that I must get at that at the earliest possible moment had already led me to make attempts to reach the head of Princess Marie Bay.

As to the spring campaign, I could not be reconciled to the idea of losing a year from the main work of the expedition, and proposed to utilize the winter moons in pushing supplies to Fort Conger, then move my party to that station early in February, and on the return of the sun, start from there as a base, and make my attempt on the pole via Cape Hecla. I *might* succeed in spite of the low latitude of my starting point, and in any event could be back to the ship before the ice broke up, with thorough knowledge of the coast and conditions north of me.

September 18, I left the ship with two sledges and my two best Eskimos, with provisions for twelve days, for a reconnoissance of Princess Marie Bay. September 20, I reached the head of a small fjord running southwest from near the head of Princess Marie Bay, and found a narrow neck of land about three miles wide separating it from a branch of Buchanan "Strait." Bache "Island" of the chart is, therefore, a peninsula, and not an island. From a commanding peak in the neighborhood I could see that both arms of Buchanan "Strait" ended about south of my position, that the "Strait" is in reality a bay, and that Hayes Sound does not exist. On the 21st and 22d, I penetrated the arms of Princess Marie Bay, designated as Sawyer and Woodward Bays on the charts, and demonstrated them to be entirely closed.

September 23d, while entering a little bight about midway of the north shore of Bache Peninsula, I came upon two bears. These my dogs chased ashore and held at bay, until I could come up and kill them.

September 25, I crossed Bache Peninsula on foot with my two men from Bear Camp to the intersection of the northern and southern arms of Buchanan Bay. Here we found numerous walrus, and could command the southern arm to the large glacier at its head. Comparatively recent musk-ox tracks convinced me of the presence of musk-ox on the peninsula. The next day I returned to the "Windward" to refit and start for Buchanan Bay via Victoria Head and Cape Albert, in the quest of walrus and musk-oxen. Henson, in a reconnoissance northward during my absence, had been unable to get more than a few miles beyond Cape Louis Napoleon, sea ice and ice-foot being alike impracticable. A day or two after my return I started him off to try it.

September 30, I started for Buchanan Bay. Between Victoria Head and Cape Albert, found fresh tracks of a herd of musk-oxen and followed them until obliterated by the wind. Reached the walrus grounds in Buchanan Bay late on October 4, and the next day secured a walrus, and the remainder of my party arrived. The following day everyone was out after musk-oxen, but, finding it very foggy on the uplands of the peninsula, I returned to camp and went up Buchanan Bay in search of bears, the track of which we had seen. Returning to camp, I found that one of my hunters had killed a bull musk-ox.

On the 7th I sent two men to bring out the meat and skin, while I went up Buchanan Bay again. Returning to camp, I found it deserted. A little later some of my party returned, reporting a herd of fifteen musk-oxen killed. The next two days were consumed in cutting up the animals, stacking the meat, and getting the skins and some of the meat out to camp. The latter had to be dragged to the top of the bluffs and thrown over.

October 10, we started for the ship, which was reached late on the 12th. The ice in Buchanan Bay was very rough, and a snow storm on the 11th made going very heavy. Five days later, October 17th, I went with two men to locate a direct trail for getting the meat out to the north side of the peninsula, but found the country impracticable, and returned to the ship on the 21st. The sun left on the 20th.

The following week was devoted to the work of preparation for the winter. A reconnoissance of Franklin Pierce Bay developed nothing but hare tracks, but Henson came in from Cope's Bay with a big bear, killed near the head of the bay. This marked the end of the fall campaign, with our winter's fresh meat supply assured and the Bache "Island"—Buchanan "Strait"—"Hayes Sound" question settled.

The next step was the inauguration of the teaming work which was to occupy us through the winter. I already had my pemmican and some miscellaneous supplies at Cape Louis Napoleon, and two sledge loads of provisions at Cape Fraser. The rapidly disappearing daylight being now too limited for effective traveling, I was obliged to await the appearance of the next moon before starting for a personal reconnoissance of the coast northward. On the 29th I left the ship with Henson and one Eskimo. The soft snow of the last two storms compelled me to break a road for the sledges with my snow shoes across Allman Bay and along many portions of the ice-foot, but in spite of this delay, we camped at Cape Louis Napoleon after a long march.

The next day we reached Cape Fraser, having been impeded by the tide rising over the ice-foot, and camped at Henson's farthest, at the beginning of what seemed an impracticable ice-foot. It was the only possible way of advance, however, as the still moving pack in the channel was entirely impassable. The following day I made a reconnoissance on foot as far as Scoresby Bay, and though the ice-foot was then entirely impracticable for sledges, I was convinced that a good deal of earnest work with picks and shovels, assisted by the leveling effects of the next spring tides, would enable me to get loaded sledges over it during the next moon. From Cape Norton Shaw I could see that by making a detour into Scoresby Bay the heavy pack could be avoided in crossing.

This stretch of ice-foot from Cape Fraser to Cape Norton Shaw is extremely Alpine in character, being an almost continuous succession of huge blocks and masses of bergs and old floes, forced bodily out of the water and up on the rocks. At Cape John Barrow a large berg had been forced up on the solid rock of the cape, until one huge fragment lay fully one hundred feet above the high-tide level.

Returning from my reconnoissance, I camped again at Cape Fraser, building the first of the snow igloos, which I intended should be constructed at convenient intervals the entire distance to Fort Conger. The next three days were occupied in bringing the supplies at Cape Louis Napoleon up to Cape Fraser, and on the 4th of November I returned to the ship.

The time until the return of the next moon was fully occupied in making and repairing sledges, bringing in beef from the cache on Bache Peninsula, and transporting supplies and dog-food to Cape Hawkes, beyond the heavy going of Allman Bay. During much of this time the temperature was in the —40°s F.

November 21. Henson and three Eskimos left with loads, and on the 22d I followed with a party of three to begin the work of the November moon. This work ended just after midnight of December 4, when the last sledges came in. It left 3,300 pounds of supplies and a quantity of dog-food at Cape Wilkes, on the north side of Richardson Bay. These supplies would have been left at Cape Lawrence had it not been for the desertion and turning back of one of my men, discouraged with the hard work, while crossing Richardson Bay. Knowing it to be essential to prevent any recurrence of the kind, I pushed on to Cape Wilkes, camped, and turned in after a twenty-five hour day, slept three hours, then started with empty sledge, eight picked dogs, and an Eskimo driver, to overtake my man. He was found at Cape Louis Napoleon, and after receiving a lesson, was taken along with me to the ship.

My party was left with instructions to bring up supplies which the wrecking of sledges had obliged me to cache at various places, assemble all at Cape Wilkes, and then, if

I did not return, reconnoitre the ice-foot to Rawlings Bay, and return to the ship.

The distance from Cape Wilkes to the "Windward" was 60 nautical miles in a straight line (as traveled by me along the ice-foot and across the bays, not less than 90 statute miles), and was covered in 23 hours and 20 minutes, or 21 hours 30 minutes' actual traveling time. Temperature during the run, —50° F.

Every sledge was more or less smashed in this two weeks' campaign, and at Cape John Barrow, sledges and loads had to be carried on our backs over the ice jams. The mean daily minimum temperature for the thirteen days was —42.2° F., the lowest, —50° F., which occurred on four successive days.

The experience gained on this trip led me to believe that the conditions of travel from Cape Wilkes northward as far, at least, as Cape Defosse, would not differ materially from those already encountered, and enabled me to lay my plans with somewhat greater detail. With the light of the December moon I would proceed to Cape Wilkes with such loads as would enable me to travel steadily without double-banking, advance everything to Cape Lawrence on the north side of Rawlings Bay, then go rapidly on to Fort Conger with light sledges, determine the condition of the supplies left there, that I might know what I could depend upon, and thus save transportation of unnecessary articles; then return to the ship.

In the January moon I would start with my entire party; move my supplies from Cape Lawrence to Fort Conger; remain there till the February moon, the light of which would merge into the beginning of the returning daylight; then sledge the supplies for the polar journey, to Cape Hecla, and be in readiness to start from there, with rested and well-fed dogs, by the middle of March.

In pursuance of this plan, the two weeks intervening between the departure of the November moon and the appearance of that of December were busily occupied in repairing

Fort Conger.

Musk-oxen, Buchanan Bay.

and strengthening sledges, and making and overhauling clothing and equipment, to enable us to meet this long and arduous journey in the very midnight of the "Great Night." During this interval the temperature, much of the time, was at —50° F. and below.

December 20, in the first light of the returning moon, I left the "Windward" with my doctor, Henson, four Eskimos, and thirty dogs, all that were left of the 60 odd of four months previous. Thick weather, strong winds rushing out of Kennedy Channel, heavy snow, and an abominable ice-foot in Rawlings Bay, delayed me, and it was not until the 28th that I had all my supplies assembled at Cape Lawrence, on the north side of Rawlings Bay.

Cape Lawrence presented the advantage of two possible routes by which these latter supplies could be reached from Conger, one through Kennedy Channel, which I was about to follow, and the other via Archer Fjord and overland. In spite of the delays, I felt, on the whole, well satisfied with the work up to the end of the year. I had all my supplies half way to Fort Conger, and had comfortable snow igloos erected at Cape Hawkes, Cape Louis Napoleon, Cape Fraser, Cape Norton Shaw, Cape Wilkes, and Cape Lawrence.

December 29, I started from Cape Lawrence with light sledges for Fort Conger, hoping to make the distance in five days. The first march from Cape Lawrence, the ice-foot was fairly good, though an inch or two of efflorescence made the sledges drag as if on sand. The ice-foot grew steadily worse as we advanced, until after rounding Cape Defosse it was almost impassable even for light sledges. The light of the moon lasted only for a few hours out of the twenty-four, and at its best it was only sufficient to permit us to select a route on the sea ice.

Just south of Cape Defosse we ate the last of our biscuit; just north of it, the last of our beans. On the next march a biting wind swept down the channel and numbed the Eskimo who had spent the previous winter in the States to such an extent that, to save him, we were obliged to halt just above Cape Cacroft, and dig a burrow in a snowdrift. When the storm ceased, I left him with another Eskimo and nine of the poorest dogs, and pushed on to reach Fort Conger.

The moon had left us entirely now, and the ice-foot was utterly impracticable, and we groped and stumbled through the rugged sea ice as far as Cape Baird. Here we slept a few hours in a burrow in the snow, then started across Lady Franklin Bay. In complete darkness and over a chaos of broken and heaved-up ice, we stumbled and fell and groped for eighteen hours, till we climbed upon the ice-foot of the north side. Here a dog was killed for food.

Absence of suitable snow put an igloo out of the question, and a semi-cave under a large cake of ice was so cold that we could stop only long enough to make tea. Here I left a broken sledge and nine exhausted dogs. Just east of us, a floe had been driven ashore, and forced up over the ice-foot till its shattered fragments lay a hundred feet up the talus of the bluff. It seemed impassable, but the crack at the edge of the ice-foot allowed us to squeeze through; and, soon after, we rounded the point, and I was satisfied by the "feel" of the shore,—for we could see nothing,—that we were at one of the entrances of Discovery Harbor, but which I could not tell.

Several hours of groping showed that it was the eastern entrance; we had struck the center of Bellot Island, and at midnight of January 6 we were stumbling through the dilapidated door of Fort Conger. A little remaining oil enabled me, by the light of our sledge cooker, to find the range, and the stove in the officers' quarters, and, after some difficulty, fires were started in both. When this was accomplished, a suspicious "wooden" feeling in my right foot led me to have my kamiks pulled off, and I found to my annoyance that both feet were frosted. Coffee from an open tin in the kitchen, and biscuit from the table in the men's room, just as they had been dropped over fifteen years ago, furnished the menu for a simple but abundant lunch.

A hasty search failing to discover matches, candles, lamps, or oil, we were forced to devise some kind of a light very quickly before our oil burned out. Half a bottle of olive oil, a saucer, and a bit of towel, furnished the material for a small native lamp, and this, supplemented by pork fat and lard, furnished us light for several days, until oil was located. Throwing ourselves down on the cots in the officers' rooms, after everything had been done for my feet, we slept long and soundly. Awakening, it was evident that I should lose parts or all of several toes, and be confined for some weeks. The mean minimum temperature during the trip was —51° F., the lowest, —63° F.

During the following weeks our life at Conger was pronouncedly *à la* Robinson Crusoe. Searching for things in the unbroken darkness of the "Great Night," with a tiny flicker of flame in a saucer, was very like seeking a needle in a haystack. Gradually, all the essentials were located, while my two faithful Eskimos brought in empty boxes and barrels and broke them up to feed the fire. The dogs left on Bellot Island were brought in, but several died before they got used to the frozen salt pork and beef, which was all I had to feed them. The natives made two attempts to reach and bring in the two men left at Cape Cracroft, but were driven back both times by the darkness and furious winds. Finally, some ten days after we left the dug-out, they reached it again, and found that the two men, after eating some of their dogs, had started for the ship on foot, the few remaining dogs following them.

On the 18th of February, the moonlight and the remaining twilight affording enough light for a fair day's march in each twenty-four hours, we started for the "Windward." My toes were unhealed, the bones were protruding through the raw stumps on both feet, and I could hardly stand for a moment. I had twelve dogs left, but their emaciated condition and the character of the road precluded riding by anyone but myself. Lashed firmly down, with feet and legs wrapped in musk-ox skin, I formed the only load of one sledge. The other carried the necessary provisions.

On the 28th we reached the "Windward," everyone but myself having walked the entire distance, of not less than 250 miles, in eleven days. Fortunately for us, and particularly for me, the weather during our return, though extremely cold, was calm, with the exception of one day from Cape Cracroft south, during which the furious wind kept us enveloped in driving snow. The mean minimum daily temperature while we were returning was —56.18° F., reaching the lowest, —65° F., the day we arrived at the "Windward."

March 3. I started one of my Eskimos for Whale Sound with a summons to the hunters there to come to me with their dogs and sledges. Between the 3d and the 14th, a party of Eskimos coming unexpectedly, the last of the musk-ox meat on Bache Peninsula was brought to the ship, and another bull musk-ox killed.

March 13. The final amputation of my toes was performed. Pending the arrival of more natives, I sent a dory to Cape Louis Napoleon to be cached, and had dog food and current supplies advanced to Cape Fraser.

March 31, a contingent of five natives and twenty-seven dogs came in. My messenger had been delayed by heavy winds and rough ice, and the ravages of the dog disease had made it necessary to send to the more southerly settlements for dogs.

April 3, Henson left with these natives and thirty-five dogs, with the instructions to move the supplies at Cape Lawrence to Carl Ritter Bay, then push on with such loads as he could carry, without double-banking, to Fort Conger, rest his dogs and dry his clothing, and if I did not join him by that time to start back.

April 19, my left foot had healed, though still too weak and stiff from long disuse for me to move without crutches. On this day I started for Fort Conger with a party of ten, some fifty dogs and seven sledges, loaded with dog food and supplies for return caches.

April 23, I met Henson returning with his party at Cape Lawrence. From there I sent back my temporary help and borrowed dogs, and went on with a party of seven, including five natives. April 28, we reached Conger.

May 4. Having dried all our gear and repaired sledges, I started for a reconnoissance of the Greenland northwest coast. I should have started two days earlier, but for bad weather. Following a very arduous ice-foot to St. Patrick's Bay, I found the bay filled with broken pack-ice, covered with snow almost thigh-deep. From the top of Cape Murchison, with a good glass, no practicable road could be seen. The following day I sent two men with empty sledges and a powerful team of dogs to Cape Beechy to reconnoitre from its summit. Their report was discouraging. Clear across to the Greenland shore, and up and down as far as the glass could reach, the channel was filled with upheaved floe fragments, uninterrupted by young ice or large floes, and covered with deep snow.

Crippled as I was, and a mere dead weight on the sledge, I felt that the road was impracticable. Had I been fit and in my usual place, ahead of the sledges breaking the ice with my snow-shoes, it would have been different. One chance remained,—that of finding a passage across to the Greenland side at Cape Lieber.

Returning to Conger, I sent Henson and one Eskimo off immediately on this reconnoissance, and later sent two men to Musk-Ox Bay to look for musk-oxen. Two days afterward they returned, reporting 16 musk-oxen killed, and Henson came in on the same day, reporting the condition of the channel off Capes Lieber and Cracroft the same as that off Capes Beechy and Murchison, and that they had been unable to get across. I now gave up the Greenland trip, and perhaps it was well that I did so, as the unhealed place on my right foot was beginning to break down and assume an unhealthy appearance from its severe treatment. As soon as the musk-ox skins and beef were brought in, the entire party, except myself and one Eskimo, went to the Bellows and Black Rock Vale for more musk-oxen. Twelve were killed here, and the skins and meat brought to Conger.

Not believing it desirable to kill more musk-oxen, and unable to do any traveling north, I completed the work of securing the meat and skins obtained; getting the records and private papers of the United States International Expedition together; securing, as far as possible, collections and property; housing material and supplies still remaining serviceable, and making the house more comfortable for the purposes of my party.

May 23. We started for the ship, carrying only the scientific records of the expedition, the private papers of its members, and necessary supplies. I was still obliged to ride continuously. Favored with abundant light and continuously calm weather, and forcing the dogs to their best, the return to the ship was accomplished in six days, arriving there May 29.

During my absence, Captain Bartlett had built at Cape D'Urville, from plans which I furnished him, a comfortable house of the boxes of supplies, double roofed with canvas, and banked in with gravel.

June 1. I sent one sledge load of provisions to Cape Louis Napoleon, and four to Cape Norton Shaw. June 6, I sent three loads to Carl Ritter Bay, and two to Cape Lawrence. On the 25th of June, the last of these sledges returned to the "Windward," and the year's campaign to the north was ended. The return from Carl Ritter Bay had been slow, owing to the abundance of water on the ice-foot and the sea ice of the bays, and the resulting sore feet of the dogs.

June 28, a sufficient number of dogs had recovered from the effect of their work to enable me to make up two teams, and Henson was sent with these, four of the natives, and a dory, to make his way to Etah and communicate with the summer ship immediately on her arrival, so that her time would not be wasted, even should the "Windward" be late in getting out of the ice.

June 29, I started with two sledges and three natives to complete my survey of Princess Marie and Buchanan Bays, and make a reconnoissance to the westward from the head of the former. My feet, which I had been favoring since my return from Conger, were now in fair condition, only a very small place on the right one remained unhealed. Traveling and working at night, and sleeping during the day, I advanced to Princess Marie Bay, crossed the narrow neck of Bache Peninsula, and camped on the morning of July 4 near the head of the northern arm of Buchanan Bay. Hardly was the tent set up when a bear was seen out in the bay, and we immediately went in pursuit, and in a short time had him killed. He proved to be a fine large specimen.

While after the bear, I noticed a herd of musk-oxen a few miles up the valley, and after the bear had been brought into camp and skinned, and we had snatched a few hours' sleep, we went after the musk-oxen. Eight of these were secured, including two fine bulls and two live calves, the latter following us back to camp of their own accord. The next three days were occupied in getting the beef to camp. I then crossed to the southern arm of Buchanan Bay, securing another musk-ox. Returning to Princess Marie Bay, I camped on the morning of the 14th at the glacier, which fills the head of Sawyer Bay.

During the following six days I ascended the glacier, crossed the ice-cap to its western side, and from elevations of from 4,000 to 4,700 feet, looked down upon the snow-free western side of Ellesmere Land, and out into an ice-free fjord, extending some fifty miles to the northwest. The season here was at least a month earlier than on the east side, and the general appearance of the country reminded me of the Whale Sound region of Greenland. Clear weather for part of one day enabled me to take a series of angles, then fog and rain and snow settled down upon us. Through this I steered by campass back to and down the glacier, camping on the 21st in my camp of the 15th.

The return from here to the ship was somewhat arduous, owing to the rotten condition of the one-year ice, and the deep pools and canals of water on the surface of the old floes. These presented the alternative of making endless detours or wading through water often waist deep. During seven days our clothing, tent, sleeping gear, and food were constantly saturated. The "Windward" was reached on the 28th of July.

In spite of the discomforts and hardships of this trip, incident to the lateness of the season, I felt repaid by its results. In addition to completing the notes requisite for a chart of the Princess Marie—Buchanan Bay region, I had been fortunate in crosing the Ellesmere Land ice-cap, and looking upon the western coast. The game secured during this trip comprised one polar bear, seven musk-oxen, three oogsook, and fourteen seals.

When I returned to the "Windward" she was round in the eastern side of Franklin Pierce Bay. A party had left two days before with dogs, sledge, and boat, in an attempt to meet me and supply me with provisions. Three days were occupied in communicating with them, and getting them and their outfit on board. The "Windward" then moved back to her winter berth at Cape D'Urville, took the dogs on board, and on the morning of Wednesday, August 2, got under way.

During the next five days we advanced some twelve miles, when a southerly wind jammed the ice on us and drifted us north, abreast of the starting point. Early Tuesday morning, the 8th, we got another start, and the ice gradually slackening, we kept under way, reached open water a little south of Cape Albert and arrived at Cape Sabine at 10 P. M.

At Cape Sabine I landed a cache and then steamed over to Etah, arriving at 5 A. M., of the 9th. Here we found mail and learned that the steamship "Diana," which the Club had sent

Lateral River of Benedict Glacier.

Cape Morris Jesup, Most Northerly Known Land.

up to communicate with me, was out after walrus. Saturday morning, the "Diana" returned, and I had the great pleasure of taking Secretary Bridgman, comanding the Club's Expedition, by the hand.

Though the year had not been marked by any startling results, it was a year of hard and continuous work for the entire party. During the year I obtained the material for an authentic map of the Buchanan Bay, Bache Peninsula, Princess Marie Bay region; crossed the Ellesmere Land ice-cap to the west side of that land, established a continuous line of caches from Cape Sabine to Fort Conger, containing some fourteen tons of supplies; rescued the original records and private papers of the Greely expedition; fitted Fort Conger as a base for future work, and familiarized myself and party with the entire region as far north as Cape Beechy.

With the exception of the supplies at Cape D'Urville, all the provisions, together with the current supplies and dog food (the latter an excessive item), had been transported by sledge.

Finally, discouraging as was the accident to my feet, I was satisfied, since my effort to reach the northwest coast of Greenland from Conger in May, that the season was one of extremely unfavorable ice condition north of Cape Beechy, and doubt, even if the accident had not occurred, whether I should have found it advisable on reaching Cape Hecla to attempt the last stage of the journey.

My decision not to attempt to winter at Fort Conger was arrived at after careful consideration. Two things controlled this decision: First, the uncertainty of carrying dogs through the winter, and second, the comparative facility with which the distance from Etah to Fort Conger can be covered with light sledges.

After the rendezvous with the "Diana," I went on board the latter ship, and visited all the native settlements, gathering skins and material for clothing and sledge equipment, and recruiting my dog teams.

The "Windward" was sent walrus hunting during my absence. The "Diana" also assisted in this work. August 25, the "Windward" sailed for home, followed on 28th by the "Diana," after landing me and my party, equipment, and additional supplies at Etah.

1899—1900.

The "Diana" seemed to have gathered in and taken with her all the fine weather, leaving us a sequence of clouds, wind, fog, and snow; which continued with scarcely a break for weeks.

After her departure, the work before me presented itself in its own natural sequence as follows: protect the provisions, construct our winter quarters, then begin building sledges, and grinding walrus meat for dog pemmican for the spring campaign.

During the first month a number of walrus were killed from our boats off the mouth of the fjord, then the usual Arctic winter settled down upon us, its monotony varied only by the visits of the natives, occasional deer hunts, and a December sledge journey to the Eskimo settlements in Whale Sound as far as Kangerd-looksoah. In this nine days' trip some 240 miles were covered in six marches, the first and last marches being 60 to 70 miles. I returned to Etah just in time to escape a severe snow storm, which stopped communication between Etah and the other Eskimo settlements completely, until I sent a party with snow-shoes, and a specially constructed sledge, carrying no load, and manned by double teams of dogs, to break the trail.

During my absence some of my natives had crossed to Mr. Stein's place at Sabine, and, January 9th, I began the season's work by starting a few sledge loads of dog food for Cape Sabine, for use of my teams in the spring journey. From this time on, as the open water in Smith Sound permitted, more dog food was sent to Sabine, and as the light gradually increased, some of my Eskimos were kept constantly

at Sonntag Bay, some twenty miles to the south, on the lookout for walrus.

My general program for the spring work was to send three divisions of sledges north as far as Conger, the first to be in charge of Henson, while I brought up the rear with the third.

From Conger I should send back a number of Eskimos, retain some at Conger, and with others proceed north from there either via Hecla or the north point of Greenland, as circumstances might determine.

I wanted to start the first division on the 15th of February; the second, a week later, and leave with the third, March 1st, but a severe storm, breaking up the ice between Etah and Littleton Island, delayed the departure of the first division of seven sledges until the 19th.

The second division of six sledges started on the 26th, and March 4th, I left with the rear division of nine sledges. Three marches carried us to Cape Sabine, along the curving northern edge of the north water. Here a northerly gale with heavy drift detained me for two days. Three more marches in a temperature of —40° F. brought me to the house at Cape D'Uville. Records here informed me that the first division had been detained here a week by stormy weather, and the second division had left but two days before my arrival. I had scarcely arrived when two of Henson's Eskimos came in from Richardson Bay, where one of them had severely injured his leg by falling under a sledge. One day was spent at the D'Urville, drying our clothing, and on the 13th I got away on the trail of the other divisions, with seven sledges, the injured man going to Sabine with the supporting party.

I hoped to reach Cape Louis Napoleon on this march, but the going was too heavy, and I was obliged to camp in Dobbin Bay, about five miles north of the Cape.

The next day I hoped on starting to reach Cape Fraser, but was again disappointed; a severe windstorm compelling me to halt a little south of Hayes Point, and hurriedly build snow igloos in the midst of a blinding drift.

All that night and the next day, and the next night, the storm continued. An early start was made on the 16th, and in calm but very thick weather we pushed on to Cape Fraser. Here we encountered the wind and drift full in our faces and violent, making our progress from here to Cape Norton Shaw along the ice-foot very trying.

The going from here across Scoresby and Richardson Bays was not worse than the year before; and from Cape Wilkes to Cape Lawrence the same as we had always found it. These two marches were made in clear but bitterly windy weather.

Another severe southerly gale held us prisoners at Cape Lawrence for a day. The 20th was an equally cruel day, with wind still savage in its strength, but the question of food for my dogs gave me no choice but to try to advance. At the end of four hours we were forced to burrow into a snow-bank for shelter, where we remained till the next morning.

In three more marches we reached Cape von Buch. Two more days of good weather brought us to a point a few miles north of Cape Defosse. Here we were stopped by another furious gale with drifting snow, which prisoned us for two nights and a day.

The wind was still bitter in our faces when we again got under way the morning of the 27th, the ice-foot became worse and worse up to Cape Cracroft, where we were forced down into the narrow tidal joint, at the base of the ice-foot; this path was a very narrow and tortuous one, frequently interrupted, and was extremely trying on men and sledges. Cape Lieber was reached on this march. At this camp the wind blew savagely all night, and in the morning I waited for it to moderate, before attempting to cross Lady Franklin Bay.

While thus waiting, the returning Eskimos of the first and second divisions came in. They brought the very welcome news of the killing of 21 musk-oxen close to Conger. They also reported the wind out in the bay as less severe than at the Cape.

I immediately got under way, and reached Conger just before midnight of the 28th, 24 days from Etah, during six of which I was held up by storms.

The first division had arrived four days, and the second two days, earlier. During this journey there had been the usual annoying delays of broken sledges, and I had lost numbers of dogs.

The process of breaking in the tendons and muscles of my feet to their new relations, and the callousing of the amputation scars, in this, the first serious demand upon them, had been disagreeable, but was, I believe, final and complete. I felt that I had no reason to complain.

The herd of musk-oxen so opportunely secured near the station, with the meat cached here the previous spring, furnished the means to feed and rest my dogs. A period of thick weather followed my arrival at Conger, and not until April 2 could I send back the Eskimos of my division.

On leaving Etah I had not decided whether I should go north from Conger via Cape Hecla, or take the route along the northwest coast of Greenland. Now I decided upon the latter. The lateness of the season and the condition of my dogs might militate against a very long journey; and if I chose the Hecla route and failed of my utmost aims, the result would be complete failure. If, on the other hand, I chose the Greenland route and found it impossible to proceed northward over the pack, I still had an unknown coast to exploit, and the opportunity of doing valuable work.

Later developments showed my decision to be a fortunate one.

I planned to start from Conger the 9th of April, but stormy weather delayed the departure until the 11th, when I got away with seven sledges.

At the first camp beyond Conger, my best Eskimo was taken sick, and the following day I brought him back to Conger, leaving the rest of the party to cross the channel to the Greenland side, where I would overtake them. This I did two or three days later, and we began our journey up the northwest Greenland coast. As far as Cape Sumner we had almost continuous road-making through very rough ice. Before reaching Cape Sumner we could see a dark water sky, lying beyond Cape Brevoort, and knew that we should find open water there.

From Cape Sumner to Polaris Boat Camp in Newman Bay, we cut a continuous road. Here we were stalled until the 21st by continued and severe winds. Getting started again in the tail end of the storm, we advanced as far as the open water a few miles east of Cape Brevoort, and camped. This open water, about three miles wide at the Greenland end, extended clear across the mouth of Robeson Channel to the Grinnell Land coast, where it reached from Lincoln Bay to Cape Rawson. Beyond it to the north and northwest, as far as could be seen, were numerous lanes and pools. The next day was devoted to hewing a trail along the ice-foot to Repulse Harbor, and on the 23d, in a violent gale accompanied by drift, I pushed on to the "Drift Point" of Beaumont (and, later, Lockwood) a short distance west of Black Horn Cliffs.

The ice-foot as far as Repulse Harbor, in spite of the road-making of the previous day, was very trying to sledges, dogs, and men. The slippery side slopes, steep ascents, and precipitous descents wrenched and strained the latter, and capsized, broke, and ripped shoes from the former.

I was not surprised to see, from the "Drift Point" igloo, that the Black Horn Cliffs were fronted by open water. The pack was in motion here, and had only recently been crushing against the ice-foot, where we built our igloo. I thought I had broken my feet in pretty thoroughly on my journey from Etah to Conger, but this day's work of handling a sledge along the ice-foot made them think they had never encountered any serious work before. A blinding snowstorm on the 24th kept us inactive. The next day I made a reconnoissance to the Cliffs, and the next day set the entire party to work hewing a road along the ice-foot. That night the temperature fell to —25° F., forming a film of young ice upon the water. The next day I moved up close to the cliffs, and then with three Eskimos reconnoitred the young ice. I found that by proceeding with extreme care it would in most places support a man.

With experienced Ahsayoo ahead, constantly testing the ice with his seal spear; myself next, and two Eskimos following, all with feet wide apart, and sliding instead of walking, we crept past the cliffs. Returning, we brushed the thin film of newly-fallen snow off the ice with our feet for a width of some four feet, to give the cold free access to it.

I quote from my diary for the 27th: "At last we are past the barrier which has been looming before me for the last ten days, the open water at the Black Horn Cliffs. Sent two of my men, whose nerves are disturbed by the prospect ahead, back to Conger. This leaves me with Henson and three Eskimos. My supplies can now be carried on the remaining sledges. Still further stiffened by the continuous low temperature of the previous night, the main sheet of new ice in front of the Cliffs was not hazardous as long as the sledges kept a few hundred feet apart, did not stop, and their drivers kept some yards away to one side. Beyond the limit of my previous day's reconnoissance there were areas of much younger ice which caused me considerable apprehension, as it buckled to a very disquieting extent beneath dogs and sledges, and, from the motion of the outside pack, was crushed up in places, while narrow cracks opened up in others. Finally, to my relief, we reached the ice-foot beyond the Cliffs, and camped."

The next day there was a continuous lane of water, 100 feet wide, along the ice-foot by our camp, and the space in front of the Cliffs was again open water. We crossed just in time.

Up to Cape Stanton we had to hew a continuous road along the foot-ice. After this the going was much better to Cape Bryant. Off this section of the coast the pack was in constant motion, and an almost continuous lane of water extended along the ice-foot. A little west of Cape Bryant, I killed two musk-oxen, the flesh of which my dogs highly appreciated. A long search at Cape Bryant finally discovered the remains of Lockwood's cache and cairn, which had been scattered by bears. At 3.30 P. M. the first of May, I left Cape Bryant to cross the wide indentation lying between Cape Bryant and Cape Britannia. Three marches, mostly in thick weather and over alternating hummocky blue ice and areas of deep snow, brought us at 1 A. M. of the 4th to Cape North (the northern point of Cape Britannia Island). From this camp, after a sleep, I sent back two more Eskimos and the twelve poorest dogs, leaving Henson, one Eskimo, and myself, with three sledges and fifteen dogs, for the permanent advance party.

From Cape North a ribbon of young ice, on the so-called tidal crack which extends along this coast, gave us a good lift nearly across the Nordenskjöld Inlet. Then it became unsafe and we climbed a heavy rubble barrier to the old floe ice inside, which we followed to Cape Benet and camped. Here we were treated to another snowstorm.

Another strip of young ice gave us a passage nearly across Mascart Inlet, until, under Cape Payer, I found it so broken up that two of the sledges and nearly all of the dogs got into the water before we could escape from it. Then a pocket of snow, thigh and waist deep, over rubble ice under the lee of the Cape, stalled us completely. I pitched the tent, fastened the dogs, and we devoted the rest of the day to stamping a road through the snow with our snow-shoes. Even then, when we started, the next day, I was obliged to put two teams to one sledge in order to move it.

Ice-Jam at Dome Cape.

Hewing a Way.

Cape Payer was a hard proposition. The first half of the distance round it, we were obliged to cut a road, and on the last half, with twelve dogs and three men to each sledge to push and pull them, snowplow fashion, through the deep snow.

Distant Cape was almost equally inhospitable, and it was only after long and careful reconnoissance that we were able to get our sledges past, along the narrow crest of the huge ridge of ice forced up against the rocks. After this, we had comparatively fair going, on past Cape Ramsay, Dome Cape, and across Meigs Fjörd as far as Mary Murray Island. Then came some heavy going, and at 11.40 P. M. of May 8, we reached Lockwood's cairn on the north end of Lockwood Island. From this cairn I took the record and thermometer deposited there by Lockwood, eighteen years before. The record was in a perfect state of preservation.

One march from here carried us to Cape Washington. Just at midnight, we reached the low point which is visible from Lockwood Island, and great was my relief to see, on rounding this point, another splendid headland, with two magnificent glaciers debouching near it, rising across an intervening inlet. I knew now that Cape Washington was not the northern point of Greenland, as I had feared. It would have been a great disappointment to me, after coming so far, to find that another's eyes had forestalled mine in looking first upon the coveted northern point.

Nearly all my hours for sleep at this camp were taken up by observations and a round of angles. The ice north from Cape Washington was in a frightful condition, utterly impracticable. Leaving Cape Washington, we crossed the mouth of the fjord, packed with blue top floe-bergs, to the western edge of one of the big glaciers, and then over the extremity of the glacier itself, camping near the edge of the second. Here I found myself in the midst of the birthplace of the "floe-bergs," which could be seen in all the various stages of formation. These "floe-bergs" are merely degraded icebergs; that is, bergs of low altitude, detached from the extremity of a glacier, which has for some distance been forcing its way along a comparatively level and shallow sea bottom.

From this camp we crossed the second glacier, then a small fjord, where our eyes were gladdened by the sight of a polar bear, which a couple of bullets from my carbine quickly transformed into dog meat for my faithful teams.

The skin of this bear I have brought back as a trophy for the Club.

It was evident to me now that we were very near the northern extremity of the land, and when we came within view of the next point ahead, I felt that my eyes rested at last upon the Arctic Ultima Thule (Cape Morris Jesup). The land ahead also impressed me at once as showing the characteristics of a musk-ox country.

This point was reached in the next march, and I stopped to take variation and latitude sights. Here my Eskimo shot a hare, and we saw a wolf-track and traces of musk-oxen. A careful reconnoissance of the pack to the northward, with glasses, from an elevation of a few hundred feet, showed the ice to be of a less impracticable character than it was north of Cape Washington. What were evidently water clouds showed very distinctly on the horizon. This water sky had been apparent ever since we left Cape Washington, and at one time assumed such a shape that I was almost deceived into taking it for land. Continued careful observation destroyed the illusion. My observations completed, we started northward over the pack, and camped a few miles from land.

The two following marches were made in a thick fog, through which we groped our way northward, over broken ice and across gigantic, wave-like drifts of hard snow. One more march in clear weather over frightful going, consisting of fragments of old floes, ridges of heavy ice thrown up to heights of twenty-five to fifty feet, crevasses and holes, masked by snow, the whole intersected by narrow leads of open water, brought us at 5 A. M on the 16th to the northern edge of a fragment of an old floe bounded by water. A reconnoissance from the summit of a pinnacle of the floe, some fifty feet high, showed that we were on the edge of the disintegrated pack, with a dense water sky not far distant.

My hours for sleep at this camp were occupied in observations, and making a transit profile of the northern coast from Cape Washington eastward.

The next day I started back for the land, and having a trail to follow and no time wasted in reconnoissance, reached it in one long march, and camped.

Leaving this camp on the 18th, as we were traveling eastward on the ice-foot, an hour later, I saw a herd of six musk-oxen in one of the coast valleys, and in a short time had secured them. Skinning and cutting up these animals, and feeding the dogs to repletion, consumed some hours, and we then resumed our march, getting an unsuccessful shot at a passing wolf as we went.

Within a mile of our next camp a herd of fifteen musk-oxen lay fast asleep; I left them undisturbed. From here on, for three marches, we reeled off splendid distances over good going, in blinding sunshine, and in the face of a wind from the east which burned our faces like a sirocco.

The first march took us to a magnificent cape (Cape Bridgman), at which the northern face of the land trends away to the southeast. This cape is in the same latitude as Cape Washington. The next two carried us down the east coast to the 83d parallel. In the first of these we crossed the mouth of a large fjord penetrating for a long distance in a southwesterly (true) direction. On the next, in a fleeting glimpse through the fog, I saw a magnificent mountain of peculiar contour which I recognized as the peak seen by me in 1895 from the summit of the interior ice-cap south of Independence Bay, rising proudly above the land to the north. This mountain was then named by me Mt. Wistar. Finally, the density of the fog compelled a halt on the extremity of a low point, composed entirely of fine glacial drift, and which I judged to be a small island in the mouth of a large fjord.

From the camp of the previous night I had observed this island (?) and beyond and over it a massive block of a mountain, forming the opposite cape of a large intervening fjord, and beyond that again, another distant cape. Open water was clearly visible a few miles off the coast, while, not far out, dark water clouds reached away to the southeast.

At this camp I remained two nights and a day, waiting for the fog to lift. Then, as there seemed to be no indications of its doing so, and my provisions were exhausted, I started on my return journey at 3.30 A. M. on the 22d of May, after erecting a cairn in which I deposited the following record:

COPY OF RECORD IN CAIRN AT CLARENCE WYCKOFF ISLAND.

Arrived here at 10.30 P. M., May 20, from Etah, via Fort Conger, and north end of Greenland. Left Etah, March 4th. Left Conger, April 15th. Arrived north end of Greenland, May 13th. Reached point on sea-ice, latitude 83° 50′ N., May 16th.

On arrival here had rations for one more march southward. Two days' dense fog have held me here. Am now starting back.

With me are my man, Mathew Henson; Ahngmalokto, an Eskimo; sixteen dogs, and three sledges.

This journey has been made under the auspices of and with funds furnished by the Peary Arctic Club of New York City.

The membership of this Club comprises Morris K. Jesup, Henry W. Cannon, Herbert L. Bridgman, John Flagler, E. C. Benedict, James J. Hill, H. H. Benedict, Fredk. E. Hyde, E. W. Bliss, H. H. Sands, J. M. Constable, C. F. Wyckoff,

E. G. Wyckoff, Chas. P. Daly, Henry Parish, A. A. Raven, G. B. Schley, E. B. Thomas, and others.

(Signed) R. E. PEARY,
Civil Engineer, U. S. N.

The fog kept company with us on our return almost continuously until we had passed Lockwood Island, but as we had a trail to follow did not delay us as much as the several inches of heavy snow that fell in a furious Arctic blizzard, which came rushing in from the polar basin, and imprisoned us for two days at Cape Bridgman.

At Cape Morris K. Jesup, the northern extremity, I erected a prominent cairn, in which I deposited the following record:

COPY OF RECORD IN NORTH CAIRN.

May 13, 1900—5 A. M.

Have just reached here from Etah via Ft. Conger. Left Etah, March 4th. Left Conger, April 15th. Have with me my man Henson, an Eskimo Ahngmalokto, 16 dogs and three sledges; all in fair condition. Proceed to-day due North (true) over sea-ice. Fine weather. I am doing this work under the auspices of, and with funds furnished by, the Peary Arctic Club of New York City.

The membership of this Club comprises Morris K. Jesup, Henry W. Cannon, Herbert L. Bridgman, John H. Flagler, E. C. Benedict, Fredk. E. Hyde, E. W. Bliss, H. H. Sands, J. M. Constable, C. F. Wyckoff, E. G. Wyckoff, Chas. P. Daly, Henry Parish, A. A. Raven, E. B. Thomas, and others.

(Signed) R. E. PEARY,
Civil Engineer. U. S. N.

May 17.

Have returned to this point. Reached 83° 50′ N. lat. due north of here. Stopped by extremely rough ice intersected by water-cracks. Water sky to north. Am now going east along the coast. Fine weather.

May 26.

Have again returned to this place. Reached point on east coast about N. Lat. 83°. Open water all along the coast a few miles off. No land seen to north or east. Last seven days continuous fogs, wind, and snow. Is now snowing with strong westerly wind. Temperature, 20° F. Ten musk-oxen killed east of here. Expect start for Conger to-morrow.

At Cape Washington, also, I placed a copy of Lockwood's record, from the cairn at Lockwood Island, with the following indorsement:

"This copy of the record left by Lieut. J. B. Lockwood and Sergt. (now Colonel) D. L. Brainard, U. S. A., in the cairn on Lockwood Island southwest of here, May 16, 1882, is to-day placed by me in this cairn on the farthest land seen by them, as a tribute to two brave men, one of whom gave his life for his Arctic work. May 29, 1900."

For a few minutes on one of the marches, the fog lifted, giving us a magnificent panorama of the north coast mountains. Very sombre and savage they looked, towering white as marble with the newly fallen snow, under their low, threatening canopy of lead-colored clouds. Two herds of musk-oxen were passed, one of 15 and one of 18, and two or three stragglers. Four of these were shot for dog food, and the skin of one, killed within less than a mile of the extreme northern point, has been brought back as a trophy for the Club.

Once free of the fog off Mary Murray Island, we made rapid progress, reaching Cape North in four marches from Cape Washington. Clear weather showed us the existence of open water a few miles off the shore, extending from Dome Cape to Cape Washington. At Black Cape there was a large open water reaching from the shore northward. Everywhere along this coast I was impressed by the startling evidences of the violence of the blizzard of a few days before. The polar pack had been driven resistlessly in against the iron coast, and at every projecting point had risen to the crest of the ridge of old ice, along the outer edge of the ice-foot in a terrific cataract of huge blocks. In places these mountains of shattered ice were 100 feet or more in height. The old ice in the bays and fjords had had its outer edge loaded with a great ridge of ice fragments, and was itself cracked and crumpled into huge swells by the resistless pressure. All the young ice which had helped us on our outward passage had been crushed into countless fragments and swallowed up in the general chaos.

Though hampered by fog, the passage from Cape North to Cape Bryant was made in 25½ marching hours. At 7 A. M. of the 6th of June, we camped on the end of the ice-foot at the eastern end of Black Horn Cliffs. A point a few hundred feet up the bluffs commanding the region in front of the cliffs showed it to be filled by small pieces of old ice held in place against the shore by pressure of the outside pack. It promised, at best, the heaviest kind of work, with the certainty that it would run abroad at the first release of pressure.

The next day, when about one-third the way across, the ice did begin to open out, and it was only after a rapid and hazardous dash from cake to cake that we reached an old floe, which, after several hours of heavy work, allowed us to climb upon the ice-foot of the western end of the cliffs.

From here on, rapid progress was made again, three more marches taking us to Conger, where we arrived at 1.30 A. M., June 10, though the open water between Repulse Harbor and Cape Brevoort, which had now expanded down

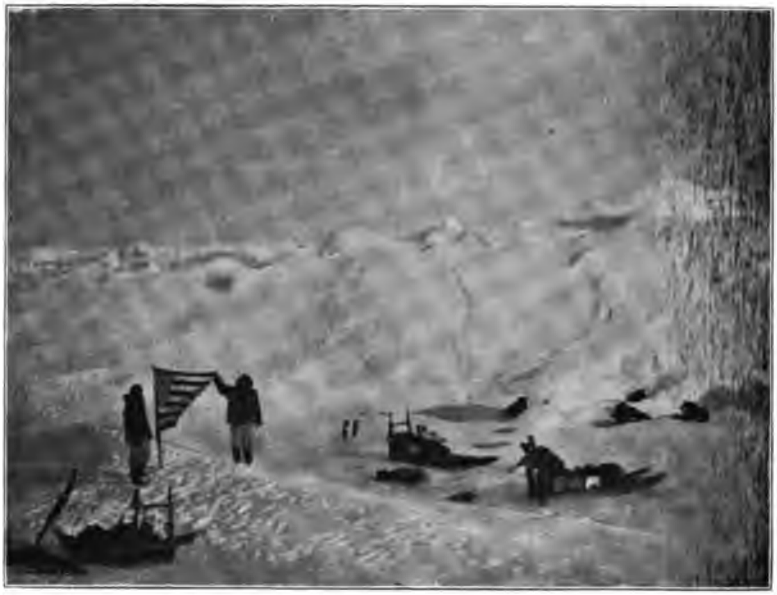
Robeson Channel to a point below Cape Sumner, and the rotten ice under Cape Sumner hampered us seriously. In passing, I took copies of the Beaumont English records from the cairn at Repulse Harbor, and brought them back for the archives of the Club. They form one of the finest chapters of the most splendid courage, fortitude, and endurance under dire stress of circumstances that is to be found in the history of Arctic explorations.

In this journey I had determined conclusively the northern limit of the Greenland Archipelago or land group, and had practically connected the coast southward to Independence Bay, leaving only that comparatively short portion of the periphery of Greenland lying between Independence Bay and Cape Bismarck indeterminate. Then non-existence of land for a very considerable distance to the northward and northeastward was also settled, with every indication pointing to the belief that the coast along which we traveled formed the shore of an uninterrupted central Polar sea, extending to the Pole, and beyond to the Spitzbergen and Franz Josef Land groups of the opposite hemisphere.

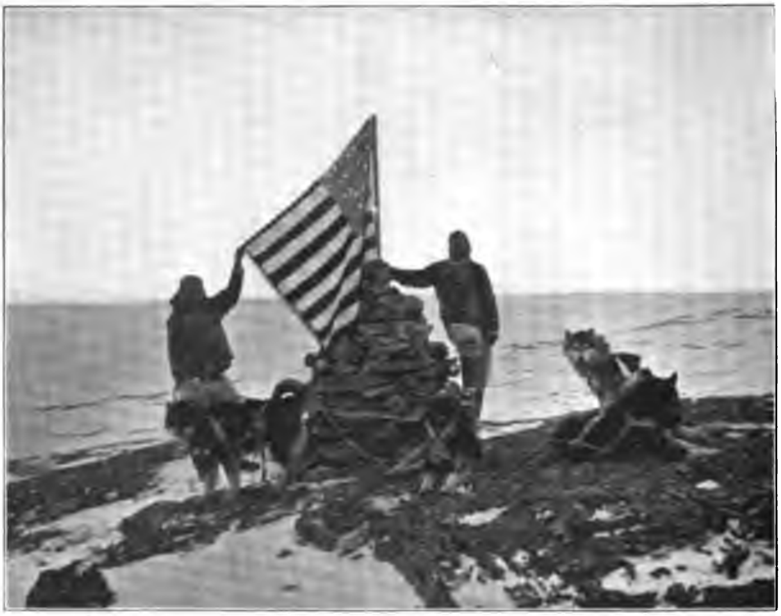
The origin of the floe-bergs and paleocrystic ice was definitely determined. Further than this, the result of the journey was to eliminate this route as a desirable or practicable one by which to reach the Pole. The broken character of the ice, the large amount of open water, and the comparatively rapid motion of the ice as it swung round the northern coast into the southerly setting East Greenland current, were very unfavorable features.

During my absence, some 33 musk-oxen and 10 seals had been secured in the vicinity of Conger; caches for my return had been established at Thank God Harbor, Cape Lieber, and Lincoln Bay, and sugar, milk, and tea had been brought up from the various caches between Conger and Cape Louis Napoleon.

July was passed by a portion of the party in the region from Discovery Harbor westward, via Black Rock



Camp at 83° 50′ N. Lat., May 16, 1900.



Cairn on Cape Morris Jesup.

Vale and Lake Hazen, where some 40 musk-oxen were secured.

During August and early September various other hunting trips of shorter duration were made, resulting in the killing of some 20 musk-oxen.

1900—1901.

The middle of September, I started with Henson and four Eskimos to Lake Hazen, to secure musk-oxen for our winter supply, it being evident that my ship would not reach us. Going west as far as the valley of the Very River, by October 4, 92 musk-oxen had been killed. Later, nine more were secured, making a total of 101 for the autumn hunting.

From the beginning of November to March 6, the greater portion of the time was passed by my party in igloos built in the vicinity of the game killed in various localities, from Discovery Harbor to Ruggles River.

April 5th, I left Conger with Henson, one Eskimo, two sledges, and twelve dogs for my northern trip. At the same time the remainder of the party with two sledges and seven dogs and pups started south for Capes D'Urville and Sabine, to communicate with or obtain tidings of my ship. On reaching Lincoln Bay, it was evident to me that the condition of men and dogs were such as to negative the possibility of reaching the Pole, and I reluctantly turned back.

Arriving at Conger, after an absence of eight days, I found the remainder of my party there. They had returned to Conger after an absence of four days, having proceeded one-third of the distance across Lady Franklin Bay.

Fortunately, the night before I arrived, one of the Eskimos secured several musk-oxen above St. Patrick's Bay, which enabled me to feed my dogs before starting south, which I did, with the entire party, on April 17.

April 30, at Hayes Point, I met the party from the "Windward" attempting to reach Conger, and received my mail, learning that the "Windward" was at Payer Harbor, with Mrs. Peary and our little girl on board. After a rest at the D'Urville box house, I went on to the "Windward," arriving May 6th.

After a few days' rest, the work of establishing new caches along the coast northward toward Conger was commenced and continued until the middle of June.

Then the preparing of Payer Harbor for winter quarters was carried on till July 3, when the "Windward" broke out of the ice and steamed over to the Greenland side.

July was devoted to killing walrus, and 128 were secured and transported to Payer Harbor.

August 4, the "Erik," sent up by the Club, in command of Secretary H. L. Bridgman, to communicate with me, arrived at Etah.

The usual tour of visits to the Eskimo settlements was then made, and both ships pressed into the work of hunting walrus until August 24, when the "Windward" proceeded southward, and the "Erik" steamed away to land me and my party and the catch of walrus at Payer Harbor.

A large quantity of heavy ice blocking the way to Payer Harbor, I requested Secretary Bridgman to land me and my party and walrus meat in a small bight, some 12 or 15 miles south of Cape Sabine, whence I could proceed to Payer Harbor in my boats or sledges when opportunity offered. This was done, and on the 29th of August the "Erik" steamed away.

1901—1902.

On the 16th of September I succeeded in reaching Payer Harbor, crossing Rosse Bay, partly by sledge and partly by boat, and going overland across Bedford Pim Island.

Soon after this, my Eskimos began to sicken, and by November 19 six of them were dead.

During this time I personally sledged much of the material from Erik Harbor to headquarters, and Henson went to the head of Buchanan Bay with some of the Eskimos and secured 10 musk-oxen.

The winter passed quietly and comfortably. Two more musk-oxen were secured in Buchanan Bay, and six deer at Etah.

January 2, work was begun in earnest on preparations for the spring campaign, which opened on the 11th of February. On this day I sent off six sledges, with light loads, to select a road across the mouth of Buchanan Bay, and build an igloo abreast of Cape Albert. On the 12th I sent two of my best hunters on a flying reconnoissance and bear hunt in the direction of Cape Louis Napoleon.

On the 13th, eight sledges went out, taking dog food nearly to Cape D'Urville. On the 16th, my two scouts returned with a favorable report, and on the 18th 10 sledges went out loaded with dog food, to be taken to Cape Louis Napoleon. This party returned on the 22d.

On the evening of the 28th everything was in readiness for Henson to start the next day, it being my intention to send him on ahead with three picked men and light loads to pioneer the way to Conger; I to follow, a few days later, with the main party.

A northerly gale delayed his departure until the morning of March 3, when he got away with six sledges and some fifty dogs. Two of these sledges were to act as a supporting party as far as Cape Lawrence.

At 9 A. M. of March 6th, fourteen sledges trailed out of Payer Harbor and rounded Cape Sabine for the northern journey, and at noon I followed them, with my big sledge, the "Long Serpent," drawn by a team of ten fine grays. Two more sledges accompanied me. The temperature at the time was —20° F. The minimum of the previous night had been —38° F.

We joined the others at the igloos abreast of Cape Albert and camped there for the night. Temperature, —43° F.

The next day we made Cape D'Urville in temperature from —45° to —49° F.

Here I stopped a day to dry our foot gear thoroughly and left on the morning of the 9th with some supplies from the box house. Two sledges returned from here. Camped about five miles from Cape Louis Napoleon. The next march carried me to Cape Fraser, and the next to Cape Collinson. During this march, for the first time in the four seasons that I have been over this route, I was able to take a nearly direct course across the mouth of Scoresby Bay, instead of making a long detour into it.

One march from Cape Collinson carried me to Cape Lawrence, on the north side of Rawlings Bay.

The crossing of this bay, though more direct than usual, was over extremely rough ice. Learning from Henson's letter, at Cape Lawrence, that I had gained a day on him, and not wanting to overtake him before reaching Conger, I remained here a day, repairing several sledges which had been damaged in the last march. Five men, with the worst sledges and poorest dogs, returned from here.

Three more marches took us to Cape von Buch, on the north side of Carl Ritter Bay, temperature ranging from —35° to —45° F. Heavy going in many places.

Two more marches carried us to the first coast valley north of Cape Defosse. I had now gained two days on the advance party. The character of the channel ice being such that we were able to avoid the terrible ice-foot which extends from here to Cape Lieber, and my dogs being still in good condition, I made a spurt from here and covered the distance to Conger in one march, arriving about an hour and a half after Henson and his party.

I had covered the distance from Payer Harbor to Conger, some 300 miles, in twelve marches.

Four days were spent at Conger, overhauling sledges and harness, drying and repairing clothing, and scouting the country as far as The Bellows, in search of musk-oxen. None were seen, but about 100 hare were secured in the four days. Temperature during this time, from —40° to —57° F. Seven Eskimos returned from here, taking with them the instruments of the Lady Franklin Bay Expedition, and other items of government property abandoned here in 1883.

On the morning of the 24th I started north with nine sledges. We camped the first night at "Depot B." The next march I had counted on making Lincoln Bay, but just before reaching Wrangel Bay, a sudden furious gale with blinding drift, drove us into camp at the south point of the bay. Here we were storm-bound during the 26th, but got away on the morning of the 27th and pushed on to Cape Union, encountering along this portion of the coast the steep side slopes of hard snow which are so trying to men and sledges and dogs.

Open water, the clouds over which we saw from Wrangel Bay Camp, was about 100 yards beyond our igloo, and extended from there, as I judged, northward beyond Cape Rawson, and reached entirely across the channel to the Greenland coast at Cape Brevoort, as in 1900.

Fortunately, with the exercise of the utmost care, and at the expense of a few narrow escapes and incessant hard work, we were able to work our sledges along the narrow and villainous ice-foot to and around Black Cape.

The ice-foot along this section of the coast was the same as was found here by Egerton and Rawson in 1876, and Pavy in 1882, necessitating the hewing of an almost continuous road; but a party of willing, light-hearted Eskimos makes comparatively easy work of what would be a slow and heartbreaking job for two or three white men. Beyond Black Cape the ice-foot improved in character, and I pushed along to camp at the "Alert's" winter quarters. Simultaneously with seeing the "Alert's" cairn, three musk-oxen were seen a short distance inland, which I went away after and secured. The animals were very thin, and furnished but a scant meal for my dogs.

One march from here carried us to Cape Richardson, and the next under the lee of View Point, where we were stopped and driven to build our igloo with all possible speed by one of the common Arctic gales. There were young ice, pools of water, and a nearly continuous water sky all along the shore.

As the last march had been through deep snow, I did not dare to attempt the English short-cut across Fielden Peninsula behind Cape Joseph Henry, preferring to take the ice-foot route around it.

For a short distance this was the worst bit of ice-foot I have ever encountered. By the slipping of my sledge, two men nearly lost their lives, saving themselves by a most fortuitous chance, with their feet already dangling over the crest of a vertical face of ice some 50 feet in height.

At the very extremity of the cape we were forced to pass our sledges over a shelf of ice less than three feet in width, glued against the face of the cliff at an elevation which I estimated at the time was 75 feet above the ragged surface of the floe beneath.

On the western side of the cape, the ice-foot broadened and became nearly level, but was smothered in such a depth of light snow that it stalled us and we went into camp. The next day we made Crozier Island.

During April 2 and 3 we were held here by a westerly storm, and the 4th and 5th were devoted to hunting musk-oxen, of which three were secured, two of them being very small.

From here I sent back three Eskimos, keeping Henson and four Eskimos with me.

During this time reconnoissances of the polar pack northward were made with glasses from the summit of the island and from Cape Hecla.

The pack was very rough, but apparently not as bad as that which I saw north of Cape Washington two years before.

Though unquestionably a hard proposition, it yet looked as though we might make some progress through it, unless the snow was too deep and soft. This was a detail which the glasses could not determine.

On the morning of April 6 I left Crozier Island, and a few hours later, at the point of Cape Hecla, we swung our sledges sharply to the right and climbed over and down the parapet of the ice-foot to the polar pack.

As the sledges plunged down from the ice-foot their noses were buried out of sight, the dogs wallowed belly deep in the snow, and we began our struggle due northward.

We had been in the field now just a month. We had covered not less than 400 miles of the most arduous traveling in temperatures of from —35° to —57° F., and we were just beginning our work, *i. e.*, the conquest of the polar pack, the toughest proposition in the whole wide expanse of the Arctic region.

Some two miles from the cape was a belt of very recent young ice, running parallel with the general trend of the coast. Areas of rough ice caught in this compelled us to exaggerated zigzags and doubling on our track. It was easier to go a mile round, on the young ice, than to force the sledges across one of these islands.

The northern edge of the new ice was a high wall of heavily rubbled old ice, through which, after some reconnoissance, we found a passage to an old floe, where I gave the order to build an igloo. We were now about five miles from the land.

The morning of the 7th brought us fine weather. Crossing the old floe, we came upon a zone of old floe fragments deeply blanketed with snow. Through the irregularities of this we struggled, the dogs floundering almost useless; now treading down the snow round a sledge to dig out a dog from the hole into which it had sunk; now lifting the sledges bodily over a barrier of blocks; veering right and left; doubling in our track; road-making with snow-shoe and pick-ax.

Late in the day a narrow ditch gave us a lift for a short distance, then one or two little patches of level going, then two or three small old floes, which, though deep with snow, seemed like a God-send compared with the wrenching work earlier. Camped in the lee of a large hummock on the northern edge of a small but very heavy old floe. Every one thoroughly tired, and the dogs utterly lifeless, dropping motionless in the snow as soon as the whip stopped.

We were now due north of Hecla, and I estimated we had made some six miles, perhaps seven, perhaps only five. A day of work like this makes it difficult to estimate distances. This is a fair sample of our days' works.

On the 12th we were stormbound by a gale from the west, which hid even those dogs fastened nearest to the igloo. During our stay here, the old floe on which we were camped split in two with a loud report, and the ice cracked and rumbled and roared at frequent intervals.

In the first march beyond this igloo, we were deflected westward by a lead of practically open water, the thin film of young ice covering it being unsafe even for a dog. A little further on, a wide canal of open water deflected us constantly to the northwest and then west, until an area of extremely rough ice prevented us from following it farther. Viewed from the top of a high pinnacle, this area extended west and northwest on both sides of the canal as far as could be seen. I could only camp and wait for this canal, which, evidently, had been widened (though not newly formed) by the storm of the day before, to close up or freeze over. During our first sleep at this camp there was a slight motion of the lead, but not enough to make it practicable. From here I sent back two more Eskimos.

Late in the afternoon of the 14th the lead began to close, and hastily packing the sledges we rushed them across over moving fragments of ice. We now found ourselves in a zone of high parallel ridges of rubble ice covered with deep snow. These ridges were caused by successive opening and closing

Payer Harbor, Winter Quarters, 1901-1902.

Camp at 84° 17′ N. Lat., April 21, 1902.

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of the lead. When after some time we found a practicable pass through this barrier, we emerged upon a series of very small but extremely heavy and rugged old floes; the snow on them still deeper and softer than on the southern side of the lead. At the end of a a sixteen-hour day I called a halt, though we were only two or three miles north of the big lead.

During the first portion of the next march we passed over fragments of very heavy old floes, slowly moving eastward. Frequently we were obliged to wait for the pieces to crush close enough together to let us pass from one to the other. Farther on, I was compelled to bear away due east by an impracticable area, extending west, northwest, north, and northeast as far as could be seen, and just as we had rounded this and were bearing away to the north again, we were brought up by a lead some 50 feet wide. From this on, one day was much like another, sometimes doing a little better, sometimes a little worse, but the daily advance, in spite of our best efforts, steadily decreasing. Fog and stormy weather also helped to delay us.

I quote from my journal for April 21st:

"The game is off. My dream of 16 years is ended. It cleared during the night, and we got under way this morning. Deep snow. Two small old floes. Then came another region of old rubble and deep snow. A survey from the top of a pinnacle showed this extending north, east, and west as far as could be seen. The two old floes over which we had just come are the only ones in sight. It is impracticable, and I gave the order to camp. I have made the best fight I knew. I believe it has been a good one. But I cannot accomplish the impossible."

A few hours after we halted, the ice to the north commenced to grind like the sound of heavy surf, and continued during our stay at this camp. Evidently, the floes in that direction were crushing together under the influence of the wind, or what was, perhaps, more probable from the long continuation of the noise, the entire pack was in slow motion to the east. A clear day enabled me to get observations which showed my latitude to be 84° 17′ 27″ N., magnetic variation, 90° west. I took some photos of the camp, climbed and floundered through the broken fragments and waist-deep snow for a few hundred yards north of the camp, gave the dogs a double ration, then turned in to sleep, if possible, for a few hours preparatory to returning.

We started on our return soon after midnight of the 21st. It was very thick, wind from the west, and snowing heavily. I hurried our departure in order to utilize as much of our tracks as possible before they were obliterated. It was very difficult to keep the trail in the uncertain light and driving snow. We lost it repeatedly, when we would be obliged to quarter the surface like bird dogs. On reaching the last lead of the upward march, instead of the open water which had interrupted our progress then, our tracks now disappeared under a huge pressure ridge, which I estimated to be from 75 to 100 feet high. Our trail was faulted here by the movement of the floes, and we lost considerable time in picking it up on the other side. This was to me a trying march. I had had no sleep the night before, and to the physical strain of handling my sledge was added the mental tax of trying to keep the trail. When we finally camped, it was only for a few hours, for I recognized that the entire pack was moving slowly, and that our trail was everywhere being faulted and interrupted by new pressure ridges and leads, in a way to make our return march nearly if not quite as slow and laborious as the outward one. The following marches were much the same. In crossing one lead I narrowly escaped losing two sledges and the dogs attached to them. Arrived at the "Grand Canal," as I called the big lead at which I had sent two Eskimos back, the changes had been such as to make the place almost unrecognizable.

Two marches south of the grand canal, the changes in the ice had been such, between the time of our upward trip and the return of my two men from the canal, that they, experienced men that they were in all that pertains to ice-craft, had been hopelessly bewildered and wandered, apparently, for at least a day without finding the trail. After their passage other changes had taken place, and as a result I set a compass course for the land and began making a new road. In the next march we picked up our old trail again.

Early in the morning of the 22d, we reached the second igloo out from Cape Hecla, and camped in a driving snow-storm. At this igloo we were storm-bound during the 27th and 28th, getting away on the 29th in the densest fog, and bent on butting our way in a "bee" line compass course for the land. Floundering through the deep snow and ice, saved from unpleasant falls only by the forewarning of the dogs, we reached Crozier Island after a long and weary march. The band of young ice along the shore had disappeared, crushed up into confused ridges and mounds of irregular blocks.

The floe at the island camp had split in two, the crack passing through our igloo, the halves of which stared at each other across the chasm. This march finished two of my dogs, and three or four more were apparently on their last legs. We did not know how tired we were until we reached the island. The warm, foggy weather and the last march, together, dropped our physical barometer several degrees.

As we now had light sledges, I risked the short-cut across the base of Fielden Peninsula and camped that night under the lee of View Point. Four more marches carried us to Conger, where we remained three days, drying clothing and repairing sledges, and giving the dogs a much needed rest. Leaving Conger on the 6th of May, eleven marches brought us back to Payer Harbor on the 17th of May. A few days after this I went north to complete the survey of the inner portions of Dobbin Bay, being absent from headquarters some 10 days. Open water vetoing a trip which I had planned for

June up Buchanan Bay and across to the west coast of Ellesmere Land, and the remainder of the time was devoted to assiduous hunting, in order to secure a supply of meat for the winter, in the contingency of no ship arriving.

On the 5th of August the new "Windward," sent north by the Club, and bringing to me Mrs. Peary and my little girl, steamed into the harbor. As soon as people and supplies could be hurried aboard her, she steamed across the sound to the Greenland side. Here my faithful Eskimos were landed, and after devoting a week or so to the work of securing sufficient walrus to carry them in comfort through the winter, the "Windward" steamed southward, and after an uneventful voyage arrived at Sydney, C. B., on the 17th of September, where I had the pleasure of meeting Secretary Bridgman of the Club, and forwarding through him a brief report of my movements during the past year.

R. E. PEARY, U. S. N.

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Some Results From the Drift Cask Experiment

BY

REAR-ADMIRAL GEORGE W. MELVILLE, U. S. N., Retired,

With Introductory Note by

PRESIDENT HENRY G. BRYANT.

On the occasion of a meeting of the American Philosophical Society, held in October, 1897, in honor of the distinguished Norwegian explorer, Dr. Fridtjof Nansen, Admiral George W. Melville suggested that valuable data concerning the speed and direction of Arctic currents might be secured by setting adrift on the floe ice north of Alaska a number of specially-constructed casks, with the idea that they would be transported by the same current which the "Jeannette" encountered—across the circumpolar area, and find outlet eventually in the seas adjacent to Franz Joseph Land, Greenland, Spitzbergen or Iceland. This interesting experiment, which promised to secure such valuable results without endangering human life, met with the approval of the Board of Directors and some fifty spindle-shaped casks, as illustrated in the accompanying photograph, were constructed, from designs submitted by Admiral Melville, and, under the auspices of this society, were sent North from San Francisco on the United States revenue cutter "Bear" and on a number of American steam whaling ships. Each cask was numbered, and contained a message in four languages requesting the finder to return the message to the address of this society. (See Fig. 2.) During the years 1899, 1900 and 1901 the casks were distributed at various points in the North by the gallant officers of the "Bear" and the hardy whalers. Detailed reports were received from the different captains stating the exact position where some 35 of the casks were set adrift. It was estimated that from three to five years would elapse before any of these messages would be heard from. As fully this much time had elapsed since the majority of the casks were launched, and no reports were forthcoming, the promoters of the enterprise began to feel some disappointment at the negative results obtained, although they never doubted that ultimately a certain percentage would work their way through. It afforded much pleasure, therefore, to those interested in the experiment when, during the latter part of October of this year, two of the messages were received in Philadelphia. An examination of the first record shows that it was cast adrift by Captain F. Tuttle, of the United States revenue cutter "Bear" on August 21, 1901, in latitude 72° 18′ N., longitude 175° 10′ W. (about 85 miles northwest of Wrangell Island), and was recovered by Captain A. G. Christianson on August 17, 1902, near the mouth of Kolyuchin Bay, on the Siberian coast. It is evident that this particular cask did not get a good start, and in the one year, less four days, of its drift, the course it followed of 380 miles to the southeast was probably influenced by local currents which exist near Bering Strait. The long delay in forwarding the message to the society may be explained on the supposition that the finder may have been engaged in a whaling voyage, or on a distant trading expedition—occupations which sometimes necessitate absence from home for two or three years. This explanation, however, is advanced here for what it is worth, as no explanatory details accompanied the paper.

The other representative of this silent fleet, which has been traversing the desolate wastes of the Arctic seas, had a longer voyage and doubtless a more eventful history. Placed on the floe ice west northwest of Point Barrow, Alaska, in latitude 71° 53′ N. and longitude 164° 50′ W., by Captain D. T. Tilton,

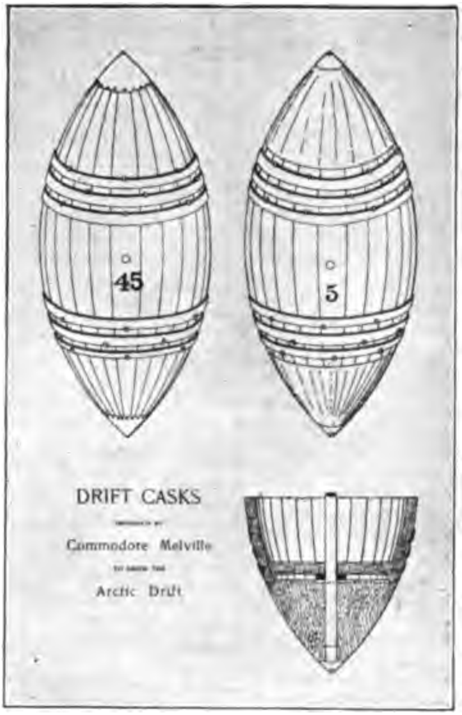

FIG. 1.

of the steam whaler "Alexander," on September 13, 1899, it was recovered one mile east of Cape Rauda Nupr, on the northern coast of Iceland, on June 7, 1905, in latitude 66° 31′ N. and longitude 16° 28′ W. There can be little doubt that this cask was transported by that slow, but persistent, current which, starting in the Arctic Sea north of Bering Strait and aided, perhaps, by the rotary movement of the earth, moves in a northwesterly direction along the Siberian coast, passing to the north of the New Siberian Islands, and, aided by the warm dischages from the Siberian rivers, gains in volume and speed and sweeps around and across the polar area north of Franz Joseph Land, emptying itself into the sea between Greenland and Spitzbergen, and thus eventually reaching the North Atlantic. The drift-cask experiment was undertaken to secure data to prove the existence of just such a current; and the safe arival of one of the flotilla, by the prescribed route, is a source of satisfaction to those who have had faith in the existence of such a current.

Assuming that the cask followed the most direct route in its journey, it is evident that it traveled about 2,500 miles in the five years, eight months and twenty-five days which elapsed. If, however, as is more probable, it followed the more circuitous routes heretofore taken in the drift of the "Jeannette" and "Fram," the entire distance traversed from a position west northwest of Point Barrow to Iceland would be fully 3,000 nautical miles. In view of the fact that, thus far, but one cask has made the journey and that over five years were occupied in transit, some may question the value of the results obtained. In answer to this view of the question, it may be well to remember, that doubtless other casks will be reported from time to time, and, in this connection, we should not forget the vast extent of the Arctic Ocean, which comprises an estimated area of between four and five million square miles, and which presents difficulties of navigation not comparable to those of the temperate zone. The remoteness of the region traversed by these casks must be considered, and it must also be remembered that even when brought to their journey's end by the great elemental forces mentioned, they are even then in regions afar from the haunts of civilized men. All these circumstances render the recovery of these messages, at best, a piece of rare good fortune.

If, by some stretch of the imagination, we could think of these inanimate oaken objects as floating laboratories, equipped with various automatic instruments for registering temperature, winds and currents and with the apparatus for securing moving picture negatives of the journey, what an interesting record it would make! An examination of the "drift" of the two casks makes one thing apparent. They were true creatures of the boreal world. Both were transferred to the ice, at points well within the Arctic Circle. One ended its long drift of nearly six years across a largely unknown area, on the very confines of the circle in distant Iceland; the other became the sport of conflicting currents and never entered the true Siberian drift; but after nearly a year's buffetings, fetched up on the Asiatic coast —just within the Arctic Circle—and a few miles only from Pitlekai, where an unkind fortune imprisoned Nördenskjold in the "Vega" late in September, 1878, causing him to spend another winter in the North after he had all but completed his memorable northeast passage.

HENRY G. BRYANT.

In the spring of 1898, I had the honor to submit a paper for publication in the BULLETIN of the society, which embodied my plans for securing information relating to Arctic currents or "drifts."[1]

To secure the desired data, it was suggested that drift casks might be utilized. This proposition was adopted and the experiment was satisfactorily carried out under the auspices of the society, as has been pointed out by President Bryant, my able coadjutor, in the preceding pages.

The recovery of two of the casks and the receipt of the two messages in Philadelphia, in October last, was most gratifying intelligence to those interested in the success of the under-taking. In considering the results we must bear in mind that, although the data that has come to hand is limited, yet every little item of ascertained facts is a contribution to knowledge and help us to solve the problems of oceanography involved. Thus the short drift of cask No. 46 must not be regarded as a neglible quantity in computing the results. It has done its share of the work, inasmuch as it has indicated, by its apparently retrograde movement, the "swirl" or series of cross currents that turn around the northwest end of Herald Island, causing the well-known "drift" dreaded by the American whalemen who fish in the Arctic Ocean north of Bering Strait. Indeed, if I mistake not, some of their ships have been caught and crushed in the ice in this vicinity and their hulks have been thrown up on the Siberian coast in just about the place where cask No. 46 was found. Unfortunately we have no means of knowing how long this cask was tossed about by adverse currents before it reached its destination; but the fact remains that it did drift in a line with the arrows representing currents shown on several standard physical charts of the region, and, therefore, has done its share in substantiating the accuracy of those publications.

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[1] "A Proposed System of Drift Casks to Determine the Direction of the Circumpolar Currents and The Drift of the Jeannette," Vol. ii., No. 3

The "drift" and finding of cask No. 6 is of greater importance from every standpoint. In making its long journey from a known position, a little north of west from Point Barrow, to a definite terminus on the north coast of Iceland, it has done much to confirm our faith in the "drift" which we believe sweeps from the sea north of Bering Strait—possibly across the pole itself—to the Atlantic Ocean.

From the data before us, we know that this particular cask has made the journey stated between known points, in the time stated, and this is the important fact. From the nature of the experiment, there are many things relating to it which we would like to know, but which must remain undisclosed. Thus it would be interesting to know how many months, or years if you will, it took to cover the distance from the point where the cask was placed on the ice until it reached open water where, had it been a ship, she could have freed herself by steam or sails and proceeded on her journey. We must bear in mind that the "drift" was made across an entirely uninhabited part of the globe, and, under these conditions, the cask may have been more than two years drifting in open water—driven hither and thither—in a comparatively open sea, before it stranded on the north coast of Iceland. The query also arises: How long may it have lain on the beach where it was, in the words inscribed on the message, "drifted ashore about one mile east of Cape Rauda Nupr, Iceland," before it was picked up by Vigfus Benidiktsson, a farmer. It is my firm belief, that these two casks are only the pioneers of others yet to be heard from. It is altogether probable that other casks, launched about the same time and in the same region, have come through and not yet been found; while others, no doubt, have been found but not reported. It is reasonable to suppose that some of them, after rounding the northern end of Greenland, have traveled south in the East Greenland currents—have passed around Cape Farewell, and may now be on the west coast of Greenland, and if they are not picked up will eventually come south in the Labrador current.

In regard to the probable course of "drift" followed by the casks, that, at present, can only be mere conjecture. We have, in this conection, to aid us the known courses of the "Jeannette" and the "Fram" across previously unknown areas, and, in additon, much accurate information relating to more accessible northern waters has been collected for several hundred years past by the ancient and honorable mariner-class of whalemen and merchantmen, while each returning Arctic explorer has added his quota to the sum total of knowledge. From time to time, all this marine data has been plotted, and we now have excellent physical charts of the known parts of the Arctic regions.

As bearing on the probable course of the casks, I may say that during the drift of the "Jeannette" in the years 1879-1881 we observed that every strong southerly wind drove our vessel from her constant northwest drift directly to the north. This course soon brought us from the thirty-six fathom depth into one of eighty-one fathoms. It was noted that on reaching the deeper water the floe took a more rapid drift to the northwest, and this continued until a northerly wind blew the floe and the ship southward again into shallow water and a more moderate drift. As cartographer of the expedition, it was my duty to plot on our chart these lines of accelerated drift in the deeper water. These lines came to be known in time to my shipmates as "Melville's Canals." In view of the fact that our cask came through, and that the resultant of the "Jeannette's" and "Fram's" drift shows a consistent trend to the northwest, the truthfulness of the term—applied at the time in a spirit of pleasant derision—acquires a new importance.

It is idle to conjecture whether or not our cask passed directly across the pole of the earth; nor are we justified, as a result of this experiment, in asserting positively that land exists or does not exist at the pole.

As strengthening the hypothesis that land will be found at, or near, the apex of the earth, several considerations may be advanced: The legends of the Alaska Eskimos refer to a land in the far North to which a number of their ancestors were driven by a storm in remote times. Here, it is said, they lived for some time, and afterwards returned to their homes and gave an account of their wanderings.[2]

In this connection also, the evidence of Arctic explorers as to the flight of aquatic birds to the north must be considered. The most obvious explanation of this movement is that they fly in this direction for the specific purpose of nesting. As these birds do not nest on the constantly-moving surface of the Arctic Ocean, it is quite reasonable to suppose; that they are winging their way to the land that lies still farther to the north —unseen as yet by human ken—where they find the rest and quiet necessary to the breeding season. It is evident that if there is any considerable land mass or large island in the position assumed, or many rocky islets, with shallow seas or channels around them, there cannot be a deep or rapid running current across the pole, and hence the cask could not have made the "drift" by that route.

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[2] Richardson, "The Polar Regions," p. 240 says:

"The Eskimos of Point Barrow have a tradition, reported by Mr. Simpson, surgeon of the Plover (in 1832), of some of their tribe having been carried to the north on ice broken up in a southerly gale, and arriving, after many nights, at a hilly country inhabited by people like themselves, speaking the Eskimo language, by whom they were well received. After a long stay, one spring in which the ice remained without movement, they returned without mishap to their own country and reported their adventures." Cited by R. A. Harris "Evidence of Land Near the North Pole." Report of Eighth Int. Geog. Congress, p. 402.

On the other hand, if the deep sea basin found to exist by Nansen at latitude 85° N. and beyond should prove to be extensive and continuous, then the fact that the deep water, which is necessary to form all great ocean currents, would exist there—would be an additional argument in favor of the presence of a definite and potential current across the area which would transport the casks over the pole.

Let this be as it may, we believe the theory of the drift is founded on good information. For the full realization of its truth, as well as the final achievement of the pole itself, we will have to wait for the intrepid mariner who, with a properly-equipped ship, has the courage and the patience to undertake the hazardous quest.

GEORGE W. MELVILLE, U. S. N.

A Regional and Economic Geography of Pennsylvania

WALTER S. TOWER.

PART I.

Physiography: The Southeast Province

INTRODUCTION

Pennsylvania has been known to the white man for nearly three centuries, until at the present time there is scarcely a remote corner which is yet to find a place in the records of literature. The humble Quaker colony has grown to be a mighty State, always one of the foremost in the annals of the history of the country. Excellent histories of the settlement and growth of the colony, from the landing of the first pioneer, are not wanting. But nowhere has there been an attempt at a similarly complete account either of the physical conditions which the settlers found, or of the influences which these conditions have exerted over the subsequent development of the State. The study of the geography of Pennsylvania is new, therefore, in the sense that it has never before been put into a connected, correlated whole.

It is but comparatively recently that the importance of physical environment has been emphasized. The last decade, almost, covers the period of any widespread, serious attempt to teach geography in its present meaning of "the study of the earth in its relations to man." The elements and principles of world geography have been thoroughly presented according to many plans. More detailed studies of the continents and important countries have also been added in the last few years.

It seems now that the most profitable field for advance is in the regional studies of small areas, as separate States, where the lesser details of environment and responses can be brought out in all their local importance, for it is really the local conditions which most closely affect the individual. To have such a series of regional studies for each State in the Union would mean a great stride toward the clearer understanding not only of the economic and social development, but also of history and political conditions as well. Regional studies should be valuable to the people both of the State and of the country at large.

The following article is one of a series which will deal with the regional and economic geography of Pennsylvania. The endeavor has been to make the presentation systematic: to describe each type of land form as a member of a class and to consider the influences which these forms have exerted as also belonging to a class of responses. Such a method seems best adapted not only for a thorough treatment of a single region, but also, if followed elsewhere, the only method which will allow ready comparison between different regions. In the discussion itself some knowledge of general geography and its processes is presupposed, and the features common to all the members of a class are ordinarily omitted. At the same time, however, a treatment too technical to be intelligible to the average reader has been avoided.

Perhaps to be logically systematic each response of life to the inorganic environment ought to appear along with the appropriate physical form. But for the sake of clearness of presentation, more readily contrasted conditions of surface form and responses, and the avoidance of frequent repetitions, it has seemed best, after trying several plans, to divide the discussion sharply: under the one head, physiography alone; under the other head, all the organic responses.

The study of the geography of Pennsylvania, in addition to original investigation, has necessitated the drawing of material from many secondary sources. To give credit to each by name is impossible either here or in the text. Especial mention, however, must be made of the detailed reports of the Second Geological Survey of Pennsylvania, directed by the late Professor J. P. Lesley, from which much valuable data was drawn. Thanks are also due Professor W. M. Davis, of Harvard University, under whom the study was begun; Dr. Philip S. Smith, of Harvard University; Professor Emory R. Johnson and Professor J. Russell Smith, of the University of Pennsylvania, and Professor G. T. Surface, of Emory and Henry College, Virginia, for many helpful criticisms and suggestions.

GENERAL RELATIONS.

The eastern part of the United States is made up of two broad physiographic provinces known as the Atlantic coastal plain, bordering directly on the ocean and the Appalachian province, lying in the main farther inland. The coastal plain extends northward from the Gulf of Mexico, narrowing as it goes, to New Jersey, where it is interrupted at Sandy Hook, and appears again only in the islands to the east.

The Appalachian province, wider and of greater linear extent, lies between the coastal plain on the east and the plains of the Mississippi Valley on the west. It rises above the coastal plain in Alabama and swings off toward the northeast as far as Newfoundland, where it is cut off by the sea. The province includes three well-marked divisions: (1) the low Piedmont hills of the older Appalachians, lying next the coastal plain; and the two types of the younger Appalachians, (2) the ridges and valleys on the east; and (3) the Allegheny-Cumberland plateau on the west. Proceeding from the south toward the north, the province as a whole narrows gradually until near the central portion in Pennsylvania, and from there it widens again rapidly as it passes into New York and New England.

The extent of Pennsylvania from east to west transverse to the Appalachian belt, combined with its location just where this province is most constricted, allows the State to share in the features of the Piedmont up to the inner border of the coastal plain as well as in those of the plateau on the west. As a result of this location, the State may be divided into districts each of which is characterized by a fairly distinct type of surface form. That this diversity of surface form must have had an important influence on the development of Pennsylvania is apparent to all. As an aid to understanding the forms themselves and the controls they have exerted, it is well to review some of the stages through which the region has passed, first in its geology and second in its physiography, to produce the surface as it is to-day.

Geological History.

The geology of the region of which Pennsylvania is a part is marked by three important stages of formation, each of which was ended by a well-marked uplift, an uplift in two cases accompanied by mountain building. These stages may be called (1) the older Appalachian period; (2) the younger Appalachian period; and (3) the Triassic period.

During pre-Cambrian time the only land mass of which we now know in the present area of Pennsylvania was in a narrow, probably mountainous, strip of crystalline rocks, extending southwest from the Canadian-Laurentian oldland, The remnants of this old axis still appear in the Green Mountains of Vermont, the Highlands of New Jersey, the South Mountain of Pennsylvania, and the Blue Ridge of the South. Along the borders of the land, deposition of stream-carried sands and gravels went on until the end of the Lower Silurian era. Then elevation of the sea floor, accompanied by mountain building, upturned the strata in the mountain ranges of the older Appalachians. The area of the land mass was increased; the greater part of present southeastern Pennsylvania came into existence, and marked the first important stage in the formation of the State.

Following the older Appalachian Mountain building, erosion on the larger, higher land mass, and deposition in the inland sea to the west went on without interruption until the close of the coal era. Thousands of feet of sediments, conglomerates, sandstones, shales and limestones, including the thick series of the coal measures, had been deposited in the deepening sea when the Permian revolution brought the eastern half of the United States above the level of the sea. Again, mountain-building forces were associated with the uplift and gave a great series of folded mountain ranges, the younger Appalachians, probably rivaling the heights of the present Alps or Andes, lying along the eastern border from Pennsylvania to Alabama. This change marked the end of the second formative period.

The Permian uplift and folding completed the area of Pennsylvania as it is made up to-day, with the exception of a narrow belt extending across the southeast corner from Bucks county on the northeast to Adams county on the southwest,—a part of a larger belt reaching from New York southward into Virginia. During Triassic time a long, narrow basin, probably the result of local depression, lay along this belt between high ranges of the older Appalachians. In it were deposited the brown ironstained sediments of the well-known building stone, and over them were extruded the associated sheets of lava. Further deposition was stopped by uplift at the end of the Triassic, apparently without much mountain building, and the formation of Pennsylvania geology was completed.

Physiographic History.

A glance at the present surface form of the State will show at once that there must have been great changes since the upturning of mountains to rival the heights of the Alps or Andes. To recall these changes in the physiography makes possible a keener appreciation of the existing conditions. It is not necessary, however, to describe in detail all the minor changes through which the region has gone in its different stages; the broader changes give the setting into which the lesser details are readily fitted.

The history of the surface form of Pennsylvania goes back to the time of the first narrow pre-Cambrian land mass, from which streams carried waste to make the strata afterward upturned in the older Appalachians. Of the character of the pre-Cambrian land little is known except that it must have been high, doubtless mountainous, to furnish the amount of waste laid down in the strata of the older Appalachians. Hardly more can be said of the old Appalachians themselves. Made during the mountain building epoch at the close of the Lower Silurian, they have since been subject to the unceasing processes of erosion, wearing them down through successive stages and changes of level, to the present well-rounded, subdued outlines of the South Mountains. How great the reduction has been, how fast it went on, or how far it had gone at most of the subsequent periods is hard to tell. But it is certain that the low hills of southeastern Pennsylvania represent the roots of once massive mountains laid bare by erosion.

It is necessary to suppose that the older Appalachians were lofty mountains since by their reduction was supplied the vast quantities of sediments which were elevated and folded into the great arches and troughs of Permian time. And it also seems probable that that reduction must have been well advanced at the beginning of the Permian revolution.

With the advent of the younger Appalachian area the physiographic history becomes clearer, for much of it can be read from the existing conditions. At the close of the mountain-building epoch the surface presented on the southeast the well-dissected ranges of the older Appalachians, west of which lay a series of great ridges; not the narrow, sharp ridges of to-day, but alternating, rounded arches and deep troughs. The folds did not continue indefinitely with horizontal axes, however, but, owing to inequalities in the mountain building forces or to the resistance of the yielding strata, the crests of the ridges and the bottoms of the troughs rose and fell away again in endless variety, with several adjacent folds often following the same control. The folds on the east nearer the oldland were most closely compressed and rose to the greatest heights, while toward the west and the north they were broader and flatter, merging into a wide undulating plateau.

The subsequent history of the region may be divided into three broad periods of denudation, each representing a separate physiographic cycle, terminated by uplift. They are (1) Cretaceous denudation and uplift; (2) Tertiary denudation and uplift; and (3) Quarternary or present denudation.

On the newly-uplifted younger Appalachian land mass weathering was soon at work; streams were developed, small consequents at first flowing in the bottoms of the great troughs; gradually, however, sending out lateral subsequent branches, working their way into the flanks of the mountains, seeking out the softer strata, and etching out deep ravines to be widened into broad valleys. All the various processes at work to wear down the land continued without interruption long enough to strip off thousands of feet of strata, sweep the upturned coal measures from the central part of the State into the sea, and by Cretaceous time to reduce the whole region of older and younger Appalachians to a broad undulating lowland.

How long a time was necessary for the denudation of the great folds is impossible to say. Neither can it be told how long the region existed as a peneplain before a general uplift transformed it into a plateau, sloping gently east and west, from heights of 1,000 to 3,000 feet, down to the Atlantic on the one hand and the Mississippi valley on the other. But that the Cretaceous lowland was widespread and almost completed, leaving only here and there low residual hills to break the broad expanse of the gently rolling plain, is shown by the existing remnants of its once continuous surface, as shown in (1) the uniformity of elevation in the crests of the present ridges of central Pennsylvania; (2) the corresponding elevations in the western plateau, where the upland surface, though much dissected by deep valleys, is the result of beveling by erosion; and (3) a similar uniformity of summit levels in the South Mountains and in the Highlands of New Jersey.

The uplift at the opening of the Tertiary again set at work all the forces of denudation to once more reduce the region to a lowland. But the process was not simple. In the series of folded strata which had been beveled across by the surface of the Cretaceous peneplain, soft shales and soluble limestones had alternated with hard sandstones and coarse conglomerates, all of which now made bands of rock, varying in width, looping across the country. As long as the region stood near sea-level the variation in texture and resistance of the strata was of little importance, for over the surface lay a thick mantle of loose waste on which the sluggish streams wandered at will across hard and soft strata alike. But when forced by uplift to deepen their valleys, the rivers found not the uniform sheet of loose waste, but compact rocks, some easily attacked, others hard and resistant. From the difference in resistance to erosion there resulted in the region of the close folds in central Pennsylvania a series of linear valleys etched out along the belts of shales and limestones, while the conglomerate and sandstone were left standing up as ridges. They are not ridges solely because the rocks were lifted to make them, but rather are they residual ridges, standing up because the region on both sides has worn down more rapidly.

In a like manner in the southeastern part of the State the dissection following uplift gave valleys where the surface was underlain by non-resistant rocks, and hills where the rocks were hard. But here there was no marked regular alternation of hard and soft layers; hence the sort of topography developed was of quite a different character.

Denudation went on uninterrupted long enough for the development of well-marked lowlands on the broader areas of less resistant strata in the central and southeast regions, and over much of the plateau, where the surface had been largely underlain by the nearly horizontal softer strata of the coal measures. This lowland is known as the Tertiary peneplain, or the Harrisburg peneplain, from its marked development in the region near Harrisburg.

The Tertiary lowland was well advanced only on the shale and limestone areas, with the hard ridges still relatively unattacked, when the region was again uplifted, and the present cycle was begun. This uplift, however, was so recent that as yet the streams have had time only to entrench themselves in narrow valleys below the level of the Tertiary lowlands, and mark the latest stage in the development of the various physiographic features as they will be described here.

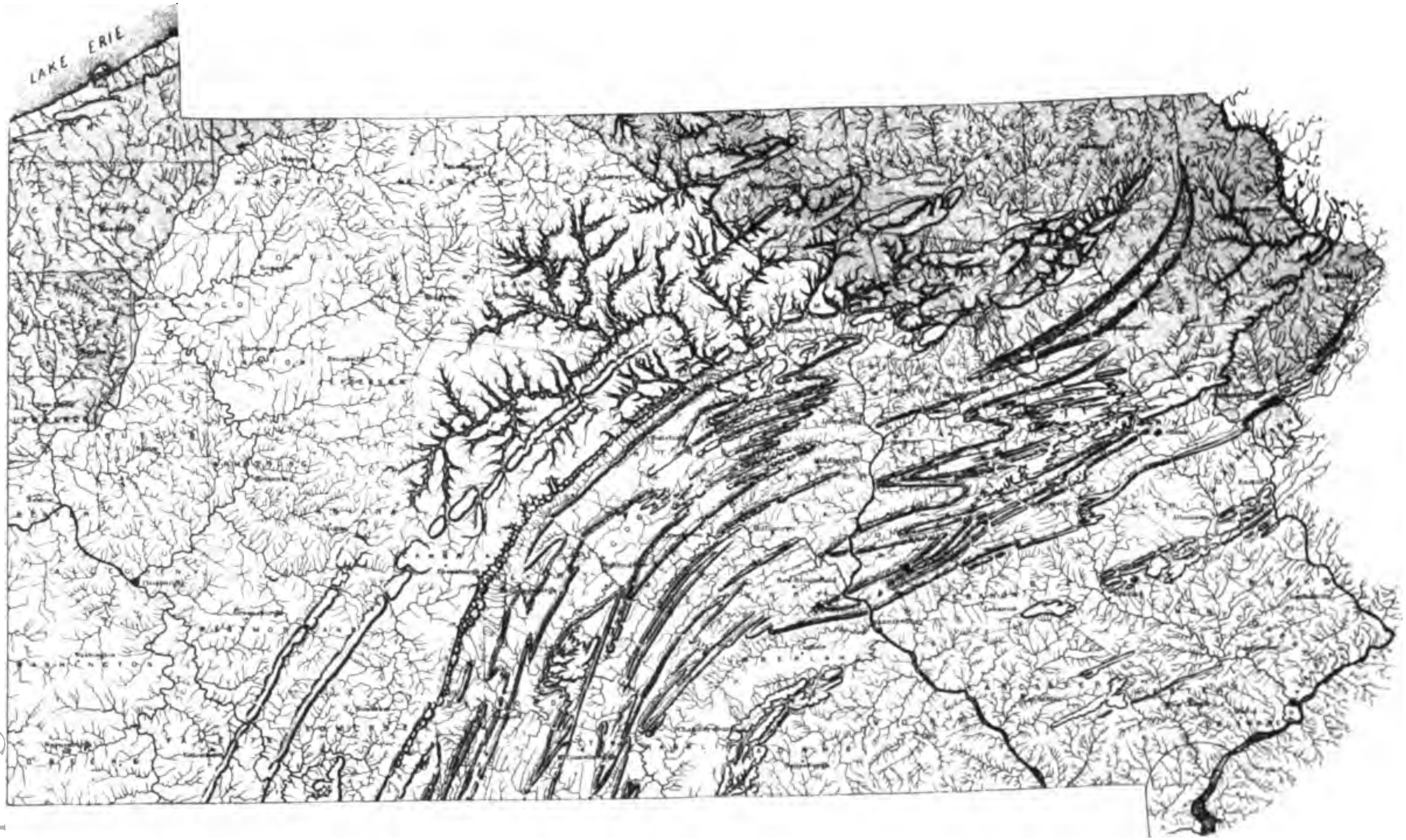

FIG 1.—Relief Map of Pennsylvania.

Drawn by J. P. Lesley for Gray & Walling's Atlas; with Glaciated Area (Cross-lined) as Outlined by H. C. Lewis and G. F. Wright.

Physiographic Divisions.

It is evident from the different stages in the formation and subsequent history of the area of which Pennsylvania is a part that the State may be divided into three natural physiographic provinces, each a part of a much larger province, and each of which is characterized by a distinct type of surface form. The divisions, as shown on the accompanying relief map (Fig. 1), are: (1) The region of the older Appalachians, including the area of the younger brown Triassic sandstone, sometimes known as the Atlantic slope, but here called the southeast province; (2) the region of the younger Appalachian ridges and valleys, here known as the central province; and (3) the region of the Allegheny plateau, in the western part of the State, known as the plateau province. It is the purpose of the following pages to describe in some detail the various physiographic features of each province, treating them not as separate items but rather as members of a class, of which other examples may be found elsewhere. The provinces will be taken up in the order named, since it was in that order that they became known to the early settlers, and largely in that order have affected the development of the State.

Southeast Province: Location and Extent and Main Divisions.

The southeast province, a part of the Piedmont region of the older Appalachians, covers the area of the South Mountains and all the region which lies in the State to the south and the east. The area is roughly quadrangular in outline. (Map Fig. 1.) Its longest western border is marked in most of its extent of nearly 150 miles by the fairly regular northeast-southwest line of the South Mountains. Its southern border is marked by the Maryland and Delaware boundaries, while on the east the angular southeast-southwest course of the Delaware River separates it from the New Jersey coastal plain. The province includes about one-ninth the area of the State, comprising the whole or parts of twelve counties.

The area in general presents the features of a worn-down mountain region, which has reached the stage of an undulating plain, from 200 to 400 feet above sea level, but traversed by ranges of residual hills or ridges, made by the harder rocks, and rising to heights of 600 or 800 or more feet above the sea. The most prominent of these residuals are the two prongs of the South Mountains; the Forrest Hills in Lebanon and Lancaster Counties; the Conewago Hills in York County, and the isolated hills and ridges of trap, like Haycock Mountain in Bucks County and Round Top in York County.

The southeast province, though taken as a separate physiographic area with respect to the rest of the State, is not characterized by the same type of topography throughout its extent. The variations in form are the result of the variation in the texture of the rocks on which that form has been developed. Just as the larger divisions of land forms are most conveniently based first on structure and then on the amount of erosion on that structure, so here the still smaller divisions are conveniently made on the basis of rock texture. For different textures, subjected to the same conditions and processes of erosion, have given different results.

In this province there are two general divisions of the strata according to their texture which have been effective in controlling surface form: (1) a series of harder rocks, chiefly gneisses and schists, fairly resistant to erosion, and forming hills; and (2) less resistant sandstone and limestones, easily eroded, giving lowlands.

The series of crystalline rocks, the schists and gneisses are represented in two main areas: (1) the belt of low hills extending from the north of Philadelphia, south and southwest into Delaware, Chester, Lancaster and York Counties, and (2) the two ranges of higher hills known as the South Mountains. All three belts represent the remnants of the older Appalachian ranges, once worn down, again elevated and redissected. From their occurrence in isolated areas which taper out in one direction or the other the term prong has been applied to them, and Professor Davis has given the separate names of the Trenton, the Reading and the Carlisle prongs, from the names of the cities located near their points.

Trenton Prong.

The rocks of the Trenton prong attain prominence near the New Jersey-Pennsylvania line, and appear in the bed of the Delaware, making the short rapids plainly visible above the railroad bridge at Trenton.

From its narrow northeastern extremity, where the hills are very low, the belt extends southwestward across Bucks County, widening gradually as it goes, to the district a few miles north of Philadelphia, known as Chestnut Hill, where the hills first become prominent. From there the range proceeds westward and southward, still widening, until it covers nearly the whole of Chester and parts of Delaware, Lancaster and York Counties. The entire area may be described as a rolling country of rather even-topped hills and shallow dales. The general elevation of the upland level rises gradually from about 400 feet in the Chestnut Hill district to 600 feet on the south, with a slope on the east down to the Delaware River. While beneath the general level the streams have cut many tortuous valleys and shallow ravines to depths of 100 or 200 feet. The hills are mainly low, often flat, dome-shaped, with rounded summits at a generally uniform level, expressive of the former base leveling, and with typical gentle slopes coated with a thick layer of soil. Steep slopes and rocky cliffs are found only where some stream, revived by the recent uplift, has, in its winding course, undercut the side of its valley, removed the blanket of loose waste from the slope and laid bare the rocks beneath. Such features, however, are not prominent elements of the landscape; it is characteristically an old, worn-down mountain region, once base-leveled and again elevated and maturely redissected.

South Mountains.

The second and larger area of ancient crystalline rocks is the belt of hills rising several hundred feet above the country on either side, known as the South Mountains, and divided into two parts, the northern, or Reading, prong, and the southern, or Carlisle, prong. The hills of the northern prong are known by different local names, all responses to geographical location. Thus in parts of Bucks County they are called the "Durham Hills"; in Berks County the "Reading Hills"; in Lehigh and Northampton Counties "South Mountain," while in some of the older books they are also spoken of a sthe "Blue Mountains."

The Reading prong, crossing the Delaware River from New Jersey, extends southwestward from near Easton to Reading, on the Schuylkill, a distance of about forty-five miles. At the New York-New Jersey line the belt is twenty miles wide, where it crosses the Delaware it is only half that width, and near Reading the range dies out entirely. Thus the Pennsylvania section occupies a roughly triangular area with the base to the northeast and the apex to the southwest. Southwest of Reading there are no true South Mountains for over forty miles. Through this interval the hill-making rocks are not exposed, and do not appear again until opposite Carlisle, in Cumberland County, where they form a series of hills and spurs which soon unite to form the South Mountain-Blue Ridge range of southern Pennsylvania, Maryland and Virginia. The gap between the Reading and Carlisle prongs is, however, partly filled by the Forrest hills in Lebanon and Lancaster Counties, in which a different set of strata repeat about the same features as are found in the South Mountains.

The Highlands of New Jersey are made up of long, parallel, continuous ridges, separated by valleys of limestone. The same conditions continue to some extent across the Delaware into the South Mountains of this State. There the hills take on a more distinct ridge-like character; they are long and rather narrow, but nowhere sharp, and are studded with numerous rounded summits. The side slopes are often steep, and the soil on them is generally thin, rocky and poor. Between the ridge hills lie secluded vales of rich farming lands, opened out on soft limestones, more or less hilly on a small scale, and directly comparable to the larger valleys of New Jersey. Similar valleys, though less numerous, are also found in other parts of the range, as Saucon Valley, occupied by the creek of the same name, and Oley Valley, near Reading.

Toward the west, however, much of the regularity of arrangement is soon lost as a consequence of less extensive and less regular bands of infolded limestones on which valleys could develop. The range consists of short, rounded, semi-detached hills, often stony and rugged, roughly ranging northeast and southwest. But although the hills over a greater part of the area are generally rounded, the southern slopes are in most cases somewhat steeper, due to the inclination of associated hard strata at a high angle toward the south. In this region, just as in the Trenton prong, the rather level summits of the highest hills reach a fairly uniform elevation here between 900 and 1,000 feet, and an occasional crest rising 100 or more feet higher represents one of the residuals on the old peneplain surface of which all the summits were a part. Though many of the hills rise to a height of 1,000 feet, the elevation of the country on either side makes the relief hardly more than half as great.

Carlisle Prong.

The chief marked difference between the Reading prong and the Carlisle prong extending south from opposite Carlisle, in Cumberland County, is in the altitude and in the more marked development of the ridge and valley type of surface as the range merges southward into the distinct single crest of the Blue Ridge. The general elevation is not less than 1,000 feet throughout the extent of the range, increasing toward the south, until along the Maryland line it reaches 2,100 feet. The relief varies from about 400 to 500 feet on the north to about 1,400 feet on the south. As a result of their greater elevation the hills appear rather less subdued than in the Reading prong, though there are still no rocky peaks and few bare cliffs. And the uniformity of upland level is also less marked over the area in general. Former base leveling, however, is distinctly shown in the flat summits, as in Great Flat Ridge.

Tertiary Lowlands—Sandstone Area.

The second division, according to texture, is the series of less resistant, Triassic sandstones, and the older limestones. They are the plain-making rocks, and are present in three well-defined areas: (1) the sandstone, typically developed in Bucks County; and the limestone regions of (2) the Chester Valley, and (3) Lancaster County.

The first of these areas, the sandstone, occurs in a single belt between the two areas of crystalline rock hills, with a northeast-southwest trend, conforming to the trend of the old Triassic basin in which the sediments were deposited. The sandstone is most widely developed in the northeast, covering almost the entire area of Bucks and Montgomery Counties between the Delaware and Schuylkill Rivers. West of the Schuylkill the belt narrows and extends with a fairly uniform width of about five miles through York and Adams Counties and on into Maryland. The whole region presents a distinctly lower level than the areas of the harder rocks both to the northwest and the southeast, best appreciated along the boundary between the two, which, though often somewhat iregular, is frequently well defined by the presence of small streams and low erosion escarpments. French Creek, tributary to the Schuylkill at Phœnixville, is a good illustration of the boundary stream with an associated escarpment.

The sandstone area in general is characterized by a rolling surface of low undulating hills, even-topped at a fairly uniform level. The majority of the uplands stand at an elevation of about 400 feet, representing the Tertiary lowland. The hills for the most part appear like many furrows, showing a distinct northeast-southwest trend, which is found to coincide with the strike of the underlying strata, and often reflects the slight variations in texture in the different sandstone layers. The relief is uniformly slight: practically all the slopes are long and gentle and covered in most places with a thick, easily-tilled and fertile soil. The streams in the northern part of the belt flow between gently-sloping valley sides, 100 or more feet below the upland level, with only here and there an approach to steeper ascents. In the more southerly part, the general level is slightly more than the average, the streams have cut somewhat deeper valleys and the presence of various harder layers has given steeper hills and low ridges.

The sandstone belt in different parts of its extent shows numerous residual hills and ridges made by the outcrops of the trap sheets extruded over the sediments of the Triassic basin. They are found nowhere else in this State, but are typical of similar areas of Triassic sandstone in New Jersey and in the Connecticut Valley. The best example of the trap hill is Haycock Mountain, six miles northeast of Quakertown, in Bucks County. The hill rises to a height of 960 feet above sea-level, with its outline implied in the name, Haycock Mountain.

The trap ridge type is best shown in the ridges of Adams County, among which is the famous Cemetery Ridge at Gettysburg, with its straight crest and steep sides. Several of the trap ridges in the northern part of the area, however, vary from the simple type, presenting a crescentic form similar to the well-known crescentic trap ridges of the Wachung Mountains in New Jersey. Good illustrations occur east of Reading, south of Boyertown, where one known as Gabel Hill at its northern end extends off several miles toward the southeast; and south of Quakertown, where a ridge four or five miles long shows some knobs rising 300 feet above the surrounding level. The Reading example is small, but distinct, showing two steep, sharp ridges, 200 feet high, with their crests a mile apart, roughly concentric in a form resembling a horseshoe. The ridges are not perfectly continuous at a uniform level, but are cut into rounded knobs separated by lower sags, while the slopes show the rough, stony condition characteristic of the trap areas in general.

Limestone Plains.

The Chester Valley, sometimes called the Little, or the Downingtown Valley, begins near Willow Grove, in Montgomery County, opening from the low sandstone plain, and extends like a narrow groove hardly more than two miles wide southwest straight across Chester County, a distance of fifty-five miles, to Quarryville, in Lancaster County. The valley has been etched out to a depth of 200 to 400 feet below the level of the surrounding country by the more rapid erosion on a narrow infolded belt of limestone. It varies from a quarter of a mile to two miles in width, with a flat, level floor, over which a few sluggish streams flow in shallow, open valleys. The valley is bounded both on the north and on the south by the higher land of the hilly belt, which, as it has stood up against erosion, makes the escarpments known as North and South Valley Hills.

Lancaster Plain.

The Lancaster area of limestone, so rich and fertile as to be known as the "Garden of the State," differs little in surface features from the Chester Valley, except that it is of greater extent and not confined between two closely-ranged boundaries of harder rock. The Lancaster plain, however, does lie perceptibly lower than the adjoining country of the Chester County hills on the southeast and the sandstone belt on the northwest, and represents the most advanced stage in the development of the Tertiary lowland. The boundary between the plain and the neighboring sandstone area, also a plain-making formation, stands out in many places as an irregular but distinct escarpment 80 to 100 feet high, very expressive of the difference in rate of erosion.

Drainage of the Southeast Province.

The southeast province is crossed by three of the four largest rivers in the State, the Susquehanna, the Delaware and the Schuylkill. The drainage is maturely developed throughout the area, and belongs entirely to these systems with the exception of the few small streams flowing to the Potomac from the hills of the Carlisle prong. Most of these streams flow in inherited, entrenched courses.

The courses of the Susquehanna, the Schuylkill and the

Delaware above Trenton lie almost squarely across the structure. The course of the Delaware below Trenton has a difernt history, and will be considered elsewhere. Nowhere in the southeast province, either in the sandstone lowlands or in the sharply defined Chester Valley are the belts of less resistant strata followed by a main longitudinal stream. Practically all the streams are flowing in inherited courses—courses developed either of the Cretaceous or on the Tertiary lowlands and maintained through subsequent uplifts. The Schuylkill affords perhaps the best example; flowing transverse to the geological structure entirely across the area, and cutting deep, narrow ravines through the crystalline hills of both the Reading and the Trenton prongs. Similar examples, just as expressive on a small scale, are afforded by Wissahickon Creek, and by Valley Creek, near Valley Forge, both tributary to the Schuylkill. Both flow across the limestone belt of the Chester Valley, which they might have followed to join the Schuylkill, but instead both cut steep-sided ravines through the crystalline belt, the former in its famous picturesque gorge in Fairmount Park, Philadelphia.

Closely analogous to the inherited course is the probable superposed origin of the set of streams flowing from the hills of the Trenton prong eastward into the Delaware, represented by Darby, Crum, Chester and Brandywine Creeks. Heading well back in the hilly belt, and especially in the case of the Brandywine draining relatively extensive areas, they all flow directly across the structure in narrow, picturesque ravines. It seems probable that these streams were developed on the strata of the coastal plain, since previous to the development of the inner lowland, the present Delaware River Valley, the now eroded strata must have overlapped the eastern border of the hilly belt. In fact, the lower course of the Brandywine is still flowing on the coastal plain sediments. With the opening out of the inner lowland, lying between the New Jersey cuesta on the one hand and the oldland of the Trenton prong on the other, these overlying strata were rapidly stripped away, and the streams were literally gradually let down or superposed on the harder rocks beneath.

Practically all the streams are flowing below the upland levels at depths varying from 100 feet or less in the upper courses of the streams in the lowlands, to 500, 600 or more feet in the South Mountain belt. Some of the valleys are narrow and steep-sided, others are wider with more gently-sloping sides, the character of the valley depending largely on the size of the stream and the region through which it flows. Thus the Schuylkill, flowing across the sandstone plain, occupies a well opened-out valley with gently sloping sides rising 200 feet to the upland level. But on entering the crystalline hills of the Trenton prong it flows in a narrow, steep-sided ravine, 300 to 400 feet deep. The valleys which the different streams have cut are partly the result of erosion in the previous cycle, as are nearly all the valleys in the crystalline areas, and partly the result of entrenchment in the present cycle.

The clearest cases of valleys due entirely to the entrenchment since recent uplift are afforded by the smaller streams flowing largely or entirely on the plain-making strata. Over these areas the Tertiary lowland was farthest advanced and the streams had developed a regular pattern of meanders before the cycle was interrupted by uplift. The meanders must have been developed on a broad valley floor, and since the only upland level is that of the dissected Tertiary lowland itself, the depth of the valleys occupied by the present entrenched meandering streams indicates the amount of erosion in the present cycle. The lower course of Conestoga Creek south of Lancaster, Big Chickies Creek to the west, Conewago Creek in York County, and Neshaminy Creek in Bucks County are good examples.

All the main streams of the region have reached grade in the present cycle, and the lower courses of some of the larger tributaries are also at grade. But the upper courses of the smaller streams, and especially those in the South Mountains, are still engaged in the process of deepening their valleys. Along the larger streams, as in the Schuylkill and the Delaware Valleys, narrow flood plains have already been developed.

The flood plains of the lower Delaware, however, are complicated by the growth of tidal marshes and mud flats, owing to the drowning of the river mouth. At some time since the elevation of the coastal plain a slow depression of the coast region allowed the sea to enter the lower portion of the Delaware Valley and convert it into the present Delaware Bay. At the same time the drowning of the river channel, with a greater depth of water, and a tide running up to the fall line at Trenton, made possible the importance of Philadelphia as a "seaport" at a distance of over 100 miles from the sea.

The lower tidal portion of the Delaware, from Trenton to the bay, makes almost a right angle with the upper course in the sharp elbow turn at Trenton from a southeast to a southwest course. For an explanation of the elbow it is necessary to go back a little in the river's history. Before the elevation of the New Jersey coastal plain the shore line stood somewhere near and closely parallel to the present southeast border of the Trenton prong. The Delaware River of that time flowing out from the oldland, entered the sea near Trenton, where traces of a delta made by it, and since elevated, are still preserved. Across this old delta, elevated along with the rest of the coastal plain, runs a deserted stream-cut valley, clear evidence that during uplift, and for some time thereafter, the Delaware flowed as an extended stream out toward the southeast, directly across the beds of the coastal plain sediments. But streams, developed on soft layers which lay along the border of the oldland, rapidly etched out a lowland; while the main subsequent, flowing solely on the softer strata, could lower its valley faster than could the larger Delaware against the effects of uplift in its course across the hard layer now making the New Jersy cuesta. Eventually, therefore, as it rapidly developed headward, the subsequent tapped the Delaware, captured its waters and diverted them to a new, the present, course at right angles to the former.

In spite of the mature development of the general drainage and the pronounced character of the Chester Valley lowland, the valley is not occupied by any main longitudinal stream. Only a few small tributaries of the larger transverse streams flow in the valley itself, and by their scarcity they suggest at once that as in most limestone areas the dissolving action of ground waters has produced many "natural" caverns and a regular system of underground drainage. The roofs of some of the caverns have fallen in, leaving small funnel shaped sink holes through which the surface water may be seen to drain. Though the Lancaster limestone plain is traversed by good-sized creeks, the development of side branches is distinctly less extensive than in other nearby areas underlain by less porous strata.

Summary of Southeast Province.

The southeast province, a part of the Piedmont region of the older Appalachians, presents two distinct types of surface form, each determined by the texture of the underlying strata: (1) The low hills of the Trenton prong and the higher hills of the Reading and the Carlisle prongs; and (2) the fertile lowlands made by the sandstone from Bucks County to the southwest, above which rise the trap hills and ridges; and the limestone plains of the Chester Valley and Lancaster County. The generally uniform elevation of the summit levels in the South Mountains represent the baseleveling which gave the Cretaceous peneplain. The upland levels of the sandstone and limestone lowlands represent Tertiary baseleveling in an interrupted cycle, and the present entrenched courses of the streams show the first stages of the present cycle. The streams present many types: the inherited transverse courses of the main rivers, the superposed courses of Brandywine Creek and its fellows, the drowned courses of the Delaware and the Schuylkill, the fall line along the southeast border of the Trenton prong, and the incised meanders in many of the entrenched courses.

The Hygiene of the Zones[1]

BY

ROBERT DEC. WARD.

Synopsis.—Introduction: some general relations of climate and health.—A complex subject.—Climate, micro-organisms and disease.—Geographical distribution of disease.—Tropics: general physiological effects.—Tropical death-rates.—Hygiene in the tropics.—Tropical diseases.—Malaria.—Yellow fever.—Dysentery: diarrhœal disorders.—Tropical abscess of the liver.—Cholera.—Plague.—Sunstroke and related conditions.—Dengue.—Beri-beri.—Other minor diseases.—General conclusions: tropics.—Temperate zones: general.—Winter and summer diseases.—Tuberculosis.—Pneumonia.—Diphtheria.—Influenza.—Bronchitis.—Rheumatism.—Measles and Scarlet Fever.—Typhoid Fever.—Whooping Cough.—Cholera Infantum.—Hay Fever.—Polar zones: general.—Scurvy.—Climate and health: general conclusions.

Introduction: Some general relations of climate and health. From earliest times people have sought in atmospheric conditions an explanation of the occurrence of disease, and have often found in statistics of mortality and of weather a more or less striking parallelism. Many fairly obvious large facts naturally point to some relation of cause and effect in this matter. Some diseases are found principally in the warmer climates; others seem to prefer the colder. Some are usually more active in the warmer, or the dryer, months; others have shown the contrary relation. Higher altitudes are free from some diseases which prevail near sea-level, and have certain favorable climatic characteristics long recognized in the treatment of disease. The pure air, increased respiration and deeper breathing are stimulating and health-giving; beneficial in many affections of the lungs, although occasionally over-stimulating in nervous and cardiac troubles. In the case of other diseases, again, altitude has no effect. Dry climates, especially deserts, whose air is usually exceptionally pure and aseptic, are generally healthful, and are beneficial in many cases where mountain climates are too stimulating. The climates within forested areas have proved especially favorable in cases of phthisis. Ocean air, pure and dust-free, with its saline constitutents and equability of temperature, is beneficial to most persons as a moderate tonic and as a restorative in many illnesses. Winds are important agents in promoting health. The cool, refreshing sea-breeze of the tropics brings in pure air from the sea and is one of the most important desiderata in hot climates. Winds are active ventilating and purifying agents where population is congested. Fogs and clouds, by cutting off sunlight, weaken one of the best agents in promoting health, for the germicidal action of sunlight has been proved by many investigators. Sternberg has called it "one of the most potent and one of the cheapest agents for the destruction of pathogenic bacteria," and says "its use for this purpose is to be recommended in making practical hygienic recommendations." In London, a higher death-rate after a long fog may, however, result from the lower temperature during the fog, and not from any direct effect of the fog itself.

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[1] This article is an attempt to give a brief survey of some of the relations between weather and climate and a few of the more important diseases. Little information upon this subject is readily accessible to the general reader. The principal reference-books used are the following:

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A complex subject. Facts like the foregoing naturally prejudice one in favor of a causal connection between atmospheric conditions and disease. Nevertheless, such studies have often led to very contradictory conclusions. Diseases usually characteristic of one zone are known to spread widely over other zones. Diseases which usually prefer the warmer months sometimes occur in the coldest. Rules, previously determined as the result of careful investigation, often break down in a most perplexing way. Some of the difficulty in this lack of agreement results from the unreliability of the statistics, often collected under very varying conditions and really not comparable. Curves are smoothed to such an extent that they can be made to show anything. Conclusions are drawn in individual cases which are neither of general application, nor do they even apply locally on any other occasion than the special one in question. Most of this disagreement comes from the fact that not only may the different weather elements themselves, temperature, moisture, wind, sunshine, and so on, each have some effect in the production of a disease, which it is impossible to determine, but so many other factors are concerned in the matter that confusion and contradiction in the conclusions reached is inevitable. Sanitation, food, water, habits, altitude, character and moisture of the soil, race, traffic, and other controls serve to complicate the problem still further. In most studies of climate and health some, or even many, of these factors have not received attention. Hence the results have usually been incomplete. Local, peculiar and temporary conditions may play a large part in the prevalence of disease. Overcrowding under unhygienic conditions, especially indoors during cold weather, and traffic by rail, steam, caravan or foot, are often more important than climate. The frequent escape of mountain, of desert and of polar peoples from epidemics is to be attributed in most cases to the smaller chance of importing disease because of little intercourse with the outside world and of spreading it, when imported, because of the scattered population. It may be noted, however, that the crowding indoors and the sparseness of population in these two cases are more or less directly climatically controlled.

Climate, micro-organisms and disease. The causation of disease is now no longer sought directly in meteorological conditions, but in the effects, more or less direct, of these conditions upon the micro-organisms which are the specific cause of the disease. Atmospheric conditions may help or may retard the development of the micro-organism, and may strengthen or weaken the individual's power of resistance against the attacks of the germ, as well as affect his susceptibility. Thus new views have replaced the old. Winds used to be regarded as the chief agents in spreading epidemics: now it is known that disease cannot be carried far by winds, for the micro-organisms do not long maintain their power in the free air and under the sun. Rain has been supposed directly to control the distribution of diseases: now we believe that precipitation acts only indirectly, through drinking water, or through its control of the dust in the air. Dust from dry soil may contain the germs of infectious diseases, and aggravates affections of the respiratory organs. Harmful exhalations are no longer believed to be given off by the soil, but the condition of the soil as to moisture and temperature may affect the development and diffusion of certain micro-organisms. Some parallelism has been discovered between the prevalence of certain diseases, such as diarrhœa and typhoid fever, and soil temperatures or the ground-water level.

Geographical distribution of disease. The scheme of classifying disease geographically, on a broad climatic basis, is attractive, but not very satisfactory. For, on the one hand, many diseases are practically universal in extent, showing great independence of climate, and on the other, the history of many diseases is still in the making. In the distribution of disease too many factors are concerned to make any simple and accurate treatment possible as yet. In spite of this complexity, however, certain broad general statements may be made, useful in enabling the layman properly to co-ordinate his ideas on the subject, and fairly accurate within reasonable limits.

Tropics: general physiological effects. The uniformity high temperatures of the tropics, especially when combined with high humidity and the characteristically small diurnal variability of temperature, have certain fairly well established physiological effects. Among these the following are commonly noted: increased respiration; decreased pulse action; profuse perspiration; lessened activity of stomach and intestines, and tendency to digestive disorders; a depression of bodily and mental activity, enervation, indifference, disinclination to exertion,—in fact, a general, ill-defined condition of debility; increased activity of the liver; surexcitation of the kidneys. In damp, hot air, evaporation from lungs is slight; the blood becomes more diluted; there is a deficiency in the number of red corpuscles in consequence of the diminished proportion of oxygen in the air. There is less power to do work; greater fatigue from work; lowered vitality. All this renders the body less able to resist disease. An anemic condition in the moist tropics is widespread.

Tropical death-rates. As compared with the death-rates in colder latitudes, tropical death-rates average high. They range from the appalling rate of 483 per 1,000 among European troops on the Gold Coast in 1829-1836, through 121 per 1,000 for European troops in Jamaica in 1820-1836, down to so low a rate as 14.84 per 1,000 for British troops in India in 1896. These death-rates, however, represent such very diverse conditions of season, climate, race, occupation, soil, mode of life, food, dwelling, etc., that they cannot legitimately be compared with one another, nor with the death-rates under different conditions in other latitudes. (A recent attempt to compare the death-rate among American troops in the Philippines with the general death-rate in certain American cities is an excellent example of the danger of comparing two totally different things.) So various and so complex are the controlling factors that critical comparative study is not worth while. Tropical death-rates are certainly high, but this fact should not be attributed solely to the dangers of the climate. Bad sanitary conditions and lack of medical attendance account for many, if not most, of the high tropical death-rates among the natives, and an irrational mode of life explains many deaths among persons coming from cooler climates. Tropical death-rates are being reduced with remarkable rapidity in all tropical countries which are wholly or partly under white control, and especially among European troops in the tropics. This is the result of experience with tropical conditions, and of the increased precautions which are now taken in selecting and caring for the men.

Hygiene in the tropics. Under the special conditions of tropical climates, the resident who comes from a cooler latitude needs to take special precautions regarding his mode of life and personal hygiene. A rational, temperate mode of life, especially the avoidance of alcoholic excess; regular exercise; non-fat-producing food; clothing suited to the climate, such as duck or linen for outside garments during the day and light woolen for the cool of the evening and night; careful attention to the site and construction of dwellings; all possible sanitary precautions; keeping cool during the warmest hours and season by the use of fans or punkahs, by frequent baths, and by abstaining from hard work; protection against mosquitoes by means of screens; frequent change of climate by returning to cooler latitudes,—all these are important. It seems like a contradiction, but it is a fact, that the danger of taking cold in the tropics is very great, and must be carefully guarded against. General Wolseley is reported to have said of the tropics, "not to get cold is to avoid almost certainly all the causes of disease," and a recent writer has well said that these words should be inscribed on the walls of all barracks in the tropics. The situation may be summed up in the rule: "Respect the sun, and rain, and wind; clothe with a view to avoiding chill, and live temperately." The danger of becoming chilled is greatest during the cooler hours of evening and night; during rains, or when cool winds blow. The skin does not react well in the tropics, hence chills are frequent with even slight temperature changes, especially when there is wind. As to the best style of dwelling for the tropics, there is no absolute agreement. The material can best be determined by the local conditions in each case: wood, stone, and thatch are employed successfully. Of whatever construction, houses should be roomy and airy, and protected against direct sunshine during the hottest hours of the day.

Tropical diseases. In addition to the physiological effects just considered, certain diseases are so much at home in the tropics that they have come to be known as *tropical diseases.* This designation, however, as Sir Patrick Manson uses it in the title of his famous work, does not mean diseases confined to the tropics, but is employed in a meteorological sense for diseases associated with, but not solely or even directly due to, high temperatures. Tropical climatic conditions, *per se,* probably do not injuriously affect the natives of the tropics any more than do the conditions of extra-tropical climates affect those who live in them.

Sir Patrick Manson has made the fact very clear that the difference between the diseases of tropical and extra-tropical latitudes lies in the specific cause of these diseases. For the development of certain disease germs, certain temperatures are required. Sometimes the temperature is too high; sometimes too low. Again, certain media are necessary in propagating certain diseases, as *e. g.,* a third organism, other than the disease germ itself, and man, who has the disease. The third organism may be a tropical species, as in the case of the tsetse fly; if so, the disease is a tropical disease. The opportunity for contracting the disease is best, or exists solely, in the tropics. Again, some diseases are the result of toxins generated by germs living in an external medium. One condition of development of these germs may be a certain high temperature. Thus the disease is a tropical disease, *e. g.,* beri-beri. On the other hand, when everything seems favorable, natural enemies of the germs themselves, or of the organism which subtends the germs, may destroy them. Dr. Manson's conclusion, which is the result of careful study, may well be accepted as an authoritative statement. "The more we learn about these diseases, the less important in its bearing on their geographic distribution, and as a direct pathogenic agency, becomes the *rôle* of temperature, *per se,* and the more the influence of the tropical fauna."

Besides the more or less direct effects of exposure to tropical sun and heat, such as sunstroke, heat exhaustion, and the like, there are malaria, in varied forms, and dysentery, the two worst enemies of white residents in the tropics; dengue; ulcers; yaws; tropical abscess of the liver, a common and dreaded disease; diseases like yellow fever, cholera and plague, which are more or less limited to certain localities, and are being hemmed in more and more by modern sanitary measures;

many other infectious diseases which are common to colder as well as warmer latitudes, and beri-beri, elephantiasis and other diseases which attack the colored races chiefly, and are therefore of a medical, rather than of a practical interest to white people. The fact that plague, and leprosy, and to some extent cholera as well, are practically limited to the tropics is the result of modern sanitary precautions in the extra-tropics. The unsanitary conditions among tropical peoples favor the spread of these, and similar, diseases, and not the climate *per se.* Nevertheless it is as clear as day, in the words of Dr. Manson, that these very unsanitary conditions are "more or less an indirect outcome of tropical climate." There is a greater variety in tropical than in extra-tropical diseases, but then many diseases common in cooler latitudes prevail also near the equator and many diseases prevail near the equator which have practically been banished from higher latitudes. Tropical climate is not the sole, or even in many cases the determining factor. Most so-called tropical diseases attack both natives and whites; sometimes the former suffer most; sometimes the latter. There is no rigid rule. But the racial element is often very potent.

Malaria. Malaria, next to tuberculosis one of the most important of diseases, was formerly considered a poisonous, gaseous emanation from the soil. It is now known to be a germ disease. In 1880, Laveran, a French army surgeon in Algiers, discovered a parasite in the blood of malarious persons. Manson later suspected mosquitoes as the means of propagating the malarial parasite. (Dr. A. F. A. King, of Washington, D. C., had advanced a similar suggestion in 1841.) Ross, at Manson's suggestion in 1894, followed up the clue in India, and established the fact. His work, and that of Grassi, Koch and others, has shown that the insect here concerued is a mosquito of the genus *Anopheles,* and that malaria is due mainly, if not solely, to the injection of the parasites into the blood of human beings by the bite of mosquitoes previously infected by biting some human being suffering from malaria.

Malaria is very widely distributed, from the polar circles to the equator, but the endemic foci, Manson points out, tend to become more numerous towards the equator. There is, on the whole, a fairly regular decrease in frequency and in severity from equator poleward. In certain parts of the tropics malaria is so prevalent and so severe that the question of residence there for the white race has been practically controlled thereby, as, for example, the Gold Coast, the mouths of the Congo and Zambesi, New Guinea, etc. The disease is commonly associated with swamps, and moist low-lying districts, while uplands and well-drained areas are usually less affected. This relation, however, seems to be somewhat less apparent in the tropics than in higher latitudes. Malaria is perennial in the tropics, with a general tendency to a maximum in the warmer or rainy season. In the temperate zone the maximum is in late summer or early autumn.

It is clear, with the mosquito-theory so well established, that Koch can say, of tropical Africa, where there are mosquitoes there is malaria, and where there are no mosquitoes there is no malaria, that the older views regarding the relation of climate and soil to malaria must have undergone some change. Nevertheless, there is still a fairly definite relation of cause and effect in this matter. For the development of the malarial parasite in the body of the mosquito a certain degree of heat is necessary, probably a mean temperature of at least 60° F. Hirsch pointed out, some years ago, that 60° F. is the limit at which malarial fevers can occur. Hence it happens that the same mosquito may be harmless at low temperatures and dangerous at higher. Rainfall is important because the malaria-bearing mosquito passes part of its life in water. Hence lakes, and especially marshes, pools and swamps are critical controls as breeding-places of the mosquitoes. Rain thus differs in its effects according to the amount of precipitation, and according to the conditions present where the rain falls. A rain which in one place floods and scours out mosquito-breeding pools, in another may just suffice to fill hollows and low-lying places where mosquitoes may then breed. Digging up the soil, whether for the first time or not, may result in hollows where puddles and pools may collect, and thus give rise to malaria. The ground-water level, by affecting soil-moisture, also plays a part, but decomposing vegetable matter is no longer believed to be an essential. Many occurrences or non-occurrences of malaria, unexplained on any meteorological grounds, may be ascribed to the presence or absence of the malaria-bearing mosquito.

The best prevention of malaria is to screen persons who have the disease, so that they cannot infect mosquitoes, and to screen all doors and windows so that healthy individuals may not be bitten by infected mosquitoes. Wholesale protection of this kind has recently been attempted in Havana, on the Isthmus of Panama, and in West Africa. The danger of being bitten by the *anopheles,* whose habits are chiefly nocturnal, is greatest at night, but residence in tropical malarial districts for white residents is always safest away from native huts and villages. The draining and filling up of swamps, pools and puddles; leveling of the surface of the ground; cultivation of the soil by planting trees or other forms of vegetation; destruction of the larvæ by pouring oil on the standing waters; location of dwellings on high, dry sites; having these dwellings properly screened,—all these precautions should be taken. Further, a rational and scientific use of quinine, and a change of climate to a higher latitude, are both very important measures in case of the contraction of the disease. Residence at an altitude of a few thousand feet, where the temperature is lower than at sea-level, is usually a sure preventive, but the mountain climates may be injurious to persons suffering from heart or lung troubles, or from rheumatism.

Relapses are very common after a malarial attack, and an anemic condition may continue for a long time. According to Koch, these relapsing cases infect the new mosquitoes each spring, but the same authority believes it possible to destroy all the parasites in such cases, before the spring comes, by the use of quinine.

Malaria is one of the greatest obstacles in the way of white occupation of many tropical countries. Ross spoke well when he said that the success of imperialism depends largely on success with the microscope. The hope for the future lies in the determined effort to destroy the malaria-bearing mosquitoes, and to protect individuals from infection by these mosquitoes. Preventable, to a large extent, malaria certainly is, but it is beyond the range of human power to eradicate the disease, certainly within any time which is of practical political interest. In the light of the new discoveries, however, white residents in the tropics are now in far less danger from malarial infection than they were a few years ago.

Yellow Fever. Yellow fever is endemic only on the eastern coast of the Americas, and on the western coast of Africa, chiefly within the tropics, although it frequently extends beyond them, as an epidemic, even to latitudes between 40° and 50°. It frequents especially the squalid quarters of seacoast towns and the shores of large navigable rivers, readily following railways, canals and other highways of travel. Within the tropics the rainy season brings the maximum prevalence of the disease; in extra-tropical latitudes, the summer and autumn. Hirsch asserts that it has not gained a foothold at temperatures below 68° F. Manson states that a temperature over 75° F. is needed for its development in epidemic form. Yellow fever weakens as cold weather approaches, and epidemics disappear when the temperature reaches 32° F., although the vitality of the germ may not be extinguished by frost (Mason). Stations more than a few hundred or thousand feet above sea-level are free from the disease, probably because of their lower temperatures. The altitude of this zone varies, but at the maximum yellow fever has only very rarely occurred as high as 4,000 feet above sea-level.

The brilliant work of Reed, Carroll, Agramonte and Guiteras has shown that the intermediate host, and the diffusing agent of the yellow fever parasite is a mosquito of the genus *Stegomyia,* which has previously been infected by biting a person suffering from yellow fever. Vigorous campaigns against the mosquito have recently produced a remarkable decrease of the disease at Havana and on the Isthmus of Panama. The endemicity of yellow fever in Rio is believed by Manson to be kept up by the continued arrival of foreigners who are susceptible to the disease. Newcomers are chiefly attacked. After one attack immunity is usually secured. Persons who have lived for some time in endemic areas without having the fever are more or less exempt, or may have the disease in a mild form. The immunity of natives who leave their home decreases with the length of their absence. Negroes enjoy comparative immunity; the yellow race is more, and the white race most, susceptible. Of the white race, northerners are more susceptible than southerners.

Dysentery: diarrhœal disorders. Dystentery occurs epidemically in all latitudes, but has its home in the warmer climates, as a whole increasing in severity and frequency with approach to the equator. Some form of dysentery is almost always present in lower latitudes, where this disease is next in importance to malaria in causing high death rates and in its lasting effects. High temperatures are clearly necessary for the development of the disease germ, but numerous other controls are also needed. The maximum is usually in the hottest months; cooler weather checks the disease. In India, the latter half of the rainy season shows the maximum. Altitude cannot be relied on to give relief from dysentery; residents on mountains often suffer more than those at lower levels. Lack of sanitary precautions, impure water, overcrowding, poor food, excesses of all kinds, are predisposing causes. The best preventive is a rational, temperate mode of life; protection of the more susceptible parts of the body against chills, and a proper regulation of the whole system. Epidemics of dysentery seem independent of the effects of wind, rain and atmospheric humidity. Immunity is not secured after one atack, one or more attacks being common.

In extra-tropical latitudes diarrhœal disorders show a similar dependence on temperature, for they are most frequent in summer and early autumn. Usually the hotter the summer the greater the prevalence and the severity of, and the higher the death-rate from, these complaints. Other factors are, however, concerned in this matter, so that "all attempts to express the diarrhœal mortality of a given place as a function of the temperature only have failed." Soil temperature is one factor between which and the death-rate from diarrhœal disorders some relation has been made out.

Tropical abscess of the liver. Rare in temperate and cool climates, tropical abscess of the liver, as the name implies, is mainly a disease of warmer latitudes and usually accompanies or follows dysentery. Among the predisposing causes the most potent are injudicious and intemperate habits, especially over-eating and over-indulgence in alcoholic beverages; insufficient exercise; exposure; chills, and in general the "congestive and degenerative conditions incidental to tropical life." Heat, malaria and dysentery are active precursors of liver abscess, in that they lower the vitality. The disease is most common during the colder or rainier season, when chills are most frequent, but temperature is not the sole control. The physiological adjustment of a person from a colder latitude to tropical conditions of climate throws a considerable strain upon the liver. The result, especially if intemperate living is indulged in, is likely to be liver abscess. Chiefly because of their disregard of proper hygiene, white men and women are generally more liable to have the disease than natives; the death-rate among white troops in the tropics is much higher than among native troops in the case of this disease. Tropical liver abscess is most, but by no means solely, to be expected in the earlier years of residence in the tropics. Persons suffering from the disease should, if possible, be sent to a temperate climate, although there are many cases of recovery even in the tropics.

Cholera. Cholera is due to the specific microbe, the *comma bacillus,* discovered by Koch in 1883. From its home in India, it has spread in great waves as an epidemic over most of the globe, the last advance reaching its maximum extension early in the decade 1890-1900 in northern Europe. Cholera has gone as far north as Bergen in Norway, and in Siberia up to about latitude 60° N. No general relations can be established between the occurrence of cholera and climatic or weather conditions. Local conditions exercise an important control. In higher latitudes, however, cholera seems most frequent towards autumn, decreasing with falling temperatures. Cholera is chiefly prevalent in low-lying places, on river banks, and where human beings are overcrowded under unsanitary conditions. The atmosphere is clearly not the agent for carrying the bacillus, for the latter does not keep its morbific character long in the free air. The principal agent in spreading the disease is traffic; but drinking water certainly also plays a part. As a whole, cholera is rarer and milder in the higher latitudes, and has decreased in Europe in cold weather, coming up again in summer. It has, however, also been active at low temperatures. With many exceptions, there may be said to be a decrease with altitude, and soil moisture may also play a part.

Plague. The specific cause of plague is a bacillus discovered by Kitasato, a pupil of Koch, in 1894, and also independently by Yersin. Formerly very widespread, plague is now confined to the subtropical districts of southern Asia and of the Mediterranean. It has become a disease of warm climates, because it depends upon the unsanitary conditions in which tropical natives live, and it attacks the poorer part of the population. Filth, famine, social misery and overcrowding are predisposing causes. The conclusions regarding the relation of plague to weather and climate are almost as numerous as are those who have investigated this subject, but it is clear that plague is not limited by isotherms, and that meteorological conditions do not spread it, or solely control it. The Indian Plague Commission concludes that there is no direct connection between plague and climate; Hirsch had previously stated that the relation is unsettled. In the tropics, however, the disease has on the whole had a cool season, and in higher latitudes a warm season maximum. As to altitude, plague has occurred at high levels, in cold, dry climates, and at low levels, where the climate is warm and moist. It has prevailed when the temperatures were so low that people suffered with the cold (Roumelia, 1737-8), and at temperatures so high that sunstrokes occurred (Smyrna, 1735). On the whole, plague has chiefly prevailed under moderately high temperature and moisture conditions, and where the soil is damp and the ground low. These facts do not, however, necessarily point to cause and effect.

The best preventives of plague are pure air and modern sanitation. In India, Haffkine has been very successful with inoculation.

Sunstroke and related conditions. Several disagreeable, and some fatal, results of heat and humidity, not to be classed as diseases, are common in the tropics, and to a considerable extent also in extra-tropical latitudes, even as far as latitude 50° to 60° N. Sunstroke and heat prostration are most common in the tropics when the air is damp during calms, and in temperate latitudes during the hottest spells of summer, when the weather conditions are tropical in character. The germ origin of sunstroke has been maintained by Sambon, but the cause is to be found in the effects of insolation, direct and reflected, the air temperatures and the undue heating of the body. The skin of white persons when exposed to the sun in the tropics often becomes burned and blistered, and travelers commonly suffer because of lack of protection of neck or limbs under sunshine. Exposure to the sun does not always explain sunstroke, for at sea the tropical sun is less fatal than on land.[2] and places with apparently similar conditions of insolation differ much as regards the prevalence of sunstroke. A great deal doubtless depends on occupation, as in the case of active muscular movement; physical condition, etc. Many forms of heat exhaustion are induced by exposure to high temperatures, but greatly aggravated by unsuitable clothing, impaired physical condition, and intemperance.

A study of the sunstroke weather of August, 1896, in the United States, led Dr. W. F. R. Phillips to conclude that the number of sunstrokes followed the excess of the temperature above the normal more closely than it did any other meteorological element; that there was no definite relation to the relative or absolute humidity, and that the liability to sunstroke increased in proportion as the mean temperature of any day approached the normal maximum temperature for that day.

Sunstroke is most common among those who are exposed to the sun, and at hard work under conditions which retard or check the cooling of the body by radiation or conduction. The best protection against sunstroke and heat prostration in general, and especially in the tropics, is to be found in the use of suitable light and loose clothing; loose, wide-brimmed and well-ventilated headgear; avoidance of exposure to sun and to high temperatures in general; the use of a white umbrella; avoidance of alcohol and of an excess of heating foods, and in a temperate life in all respects. Poor health, fatigue and violent exercise are all predisposing causes. Tropical camps should be located in cool and well-ventilated places, and tents should have double roofs.

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[2] Stokers and firemen suffer from prostration on steamers in the tropics, but here artificial heat is partly responsible.

Dengue. Dengue is a "highly infectious, febrile disease, characterized by severe rheumatoid pains in joints and limbs, and in some cases by a cutaneous eruption of varying character and duration." It is distinctly a disease of warm climates, although it has occurred as far north as latitude 40° in Europe and in North America, and as far south as the southern tropic. It comes mostly in the hottest months, and is practically without exception checked by cold weather. Moisture has a subordinate influence. Dengue resembles yellow fever in its prevailing preference for coasts, deltas and large river valleys; in its relation to overcrowding and unsanitary conditions, and in its advance along routes of travel. Dengue attacks any race, and immunity is not secured by one attack. There is often a frequent recurrence.

Beri-Beri. A dropsical affection, combined with a disturbance of motion and sensation, and of heart action, beri-beri is found principally in or near the tropics, being especially common in the Malay Peninsula, and the adjacent archipelago, where it is often a scourge. It is especially liable to break out among gangs of laborers. Beri-beri epidemics are most common during the rainy season. High temperature and dampness are controlling factors, as are poor health, fatigue, privation, chill, over-crowding, etc. Damp years are apt to be marked by the severity and prevalence of beri-beri.

Other minor diseases. Among the minor tropical diseases may be named sleeping sickness, limited to tropical Africa and almost wholly confined to the negro, and yaws, also distinctly tropical in distribution, requiring high temperature and moisture, found chiefly in some of the larger island groups, and principally affecting the negro.

General conclusions: tropics. All parts of the equatorial zone are not equally disagreeable or hostile so far as occupation by the white race is concerned. Many elderly persons and those who are overworked may find rest from nervous tension in the enervating climate of the tropics. The dryer districts are to be preferred to the moister, the higher altitudes to the lowlands, coasts and islands well ventilated by prevailing winds to regions where the air is stagnant. Much-needed relief from the heat at sea-level may be obtained by resort to tropical mountain stations, and many of these have become well-known health resorts. Tropical mountain climates resemble the climate of the temperate zones in their lower temperatures and in certain other ways, but they can never be the equivalent of a temperte zone climate, for they lack the seasonal changes. Some tropical climatic characteristics disappear with altitude while others change little. The non-seasonal character of tropical mountain climates, the so-called "perpetual spring," is not by any means the best fitted for man's physical and mental development, however pleasant it may be for a time. With increase of altitude, there is a decrease in or a disappearance of some of the diseases which prevail near sea level, such as malaria, yellow fever, liver abscess, etc. In their stead, however, may come an increasing frequency of diseases which are characteristic of high latitudes, such as rheumatism, and heart and lung troubles. Tropical hill stations in India show a smaller mortality among the troops than do lower levels. In India, as elsewhere in the tropics, hill stations are beneficial in restoring those who are exhausted by overwork or by the heat of the lowlands. They are especially advantageous for delicate women and children. Nevertheless, climates which are temperate because of altitude in the tropics cannot replace climates which are "temperate" because of latitude.

The acclimatization of the white race in the tropics is a question of vast importance. Upon it depends the control, government and utilization of the tropics. It is a very complex problem, and it has been much discussed. It is complicated by the controls exercised by race, diet, occupations, habits of life, and the like. To discuss it fully is impossible at this time. The gist of the matter is this: White residents from cooler latitudes on coming into the tropics must adjust themselves physiologically to the new climatic conditions. During this adjustment there is more or less strain on various organs of the body. The strain may be too severe; then the individual suffers. The adjustment is usually much retarded and hindered by a persistence in habits of food, drink, and general mode of life which, however well suited to the home climate, do not fit tropical conditions. During the adjustment, especially if complicated by irrational habits, the body is naturally sensitive to the new diseases to which it is exposed. Even should no specific disease be contracted, there are anemic tendencies and other degenerative changes. Experience teaches that white men cannot with impunity do hard manual labor under a tropical sun, but that they may enjoy fairly good health as overseers or at indoor work, if they take reasonable precautions. Acclimatization in the full sense of having white men and women living for successive generations in the tropics, and reproducing their kind without physical, mental and moral degeneration,—*i. e.,* colonization, in the true sense,—is impossible. Tropical disease and death rates, as has been abundantly shown, can be much reduced by proper attention to sanitary laws, so that these rates may be not much, if any, higher than those in the extra-tropics. And with increasing medical knowledge of the nature and prevention of tropical diseases, as well as by means of modern sanitary methods, a white resident in the tropics will constantly become better able to withstand disease. As Manson has put it, acclimatization is less "an unconscious adaptation of the physiology of the individual" than "an intelligent adaptation of his habits." For greater comfort, for better health and for greater success, properly selected hill stations will, however, always be essential to northerners who have to live in the tropics, especially to white women and children.

It has been well said that the white soldier in the tropics is "always in campaign; if not against the enemy, at least against the climate." This sentence may be made to fit the case of the white civilian in the tropics by making it read: the white race in the tropics is always in campaign against its enemy, the climate.

Temperate Zones: general. Far from being temperate as regards the general climatic conditions over much of the land area of the so-called temperate zones, these belts rightly deserve their name in the sense that in their physiological effects they are intermediate between the equatorial and the polar zones. In the temperate zones the organs of the body act more equally than in the warmer or the cooler latitudes. In the central part of the temperate zones, especially over the continents, are found the four seasons. The winter cold is met by means of warm clothing, heated houses, and other means of protection. Unless too severe, or too prolonged, when deaths by freezing may occur, the cold of a north temperate zone continental winter acts as a healthful stimulant upon body and mind. In the tropics, the body is unused to adjusting itself to temperature changes, and is readily affected by them, because such changes are there slight. But the frequent, sudden and severe changes of many parts of the temperate zone are usually borne without serious discomfort or injury, if the body is in good health, and is accustomed to adjusting itself readily to these changes. The habit of keeping houses very warm during the winter, and of having the air indoors very dry, weakens the body's power to resist the great cold outdoors, especially if the air be damp, and favor affections of throat, lungs and nose. The summers, although hot in the lower latitudes of these zones, and marked by spells of warm weather even to their polar limits, are not characterized by such steady, uniformly moist, heat as is typical of the tropics. When the heat is extreme, and the relative humidity is high, night and day, sunstroke and kindred affections are occasionally noted in places, but the invigorating cool of autumn and winter are never far off, and may always be trusted to bring relief.

Winter and summer diseases. It is natural that marked seasonal and sudden weather changes, such as those which characterize much of the temperate zones, especially in the northern hemisphere, should be reflected in the character, distribution and frequency of the diseases which are found in these zones. Diseases of the respiratory system; bronchial and rheumatic affections, diseases that result from colds and chills, pneumonia, bronchitis, influenza, diphtheria, whooping cough, are common in climates with sudden marked temperature changes, especially if those changes are accompanied by cold, damp winds. These diseases are also most frequent in the winter months, when the weather changes are more common and more severe, and when, in consequence, the vitality of the body is lowered and its power of resistance against the attack of disease germs is weakened. A greater prevalence of diseases of the respiratory organs, catarrhs and rheumatic affections has been shown by Weber in cool, moist weather, with sudden changes, and several investigators have found a higher mortality after a greater variability of temperature. Many contagious or infectious diseases, such as diphtheria, influenza, measles and scarlet fever, for example, are also more common in the colder season, not because the lower temperatures are the direct controlling factor, but largely because the colder weather drives people indoors; houses and buildings generally are less well ventilated; more clothing is worn, less attention is paid to personal cleanliness, and there is increased opportunity for contagion, especially among the poorer classes. Obviously, these are indirect effects of meterorological conditions. Other factors, also, must be taken into consideration. Thus one reason why the natives of the farther north, where the winters are very severe, suffer less from some of the diseases which are common in warmer latitudes is not because of the lower temperatures, but because they are less exposed to contagion owing to less communication with the outside world.

In the warmer months, fevers and diseases of the digestive system, diarrhœa, malaria, typhoid fever, are prevalent. Thus there are usually two maxima of mortality: one in the colder season, when the variability of temperature is greatest, chiefly due to respiratory diseases, and another in the warmer months, largely due to infant mortality from diarrhœal disorders.

Tuberculosis. "A nationally self-inflicted, unnecessary and preventible pestilence;" world-wide in extent; found in every variety of climate, and at all altitudes; causing from 10 to 15 per cent. of all deaths; the scourge of the temperate zone, tuberculosis, is on the whole less frequent in higher latitudes, on mountains, and in arid or semi-arid districts. Climate, however, is not the controlling factor in the latter cases, but sparseness of population, and infrequency of communication with the outside world. The density of population; the social and economic conditions; the occupations and habits of the people,—these are important controls. Overcrowding amid unsanitary surroundings, absence of sunlight, impure air, are predisposing causes. Weather, or other conditions which decrease the vitality, increase the susceptibility to tuberculosis. Sudden temperature changes, especially with high relative humidity at low temperatures, cause chills and lower vitality.

Consumption, it is clear, can be successfully treated where pure air, abundant sunshine, good food and outdoor exercise are to be had. The first of these desiderata, pure air, and plenty of it, is the most important of all. It is usually found on desert, ocean, mountain, and in forest. Hence such climates are generally advantageous in the treatment of tuberculosis of various kinds. Yet climate is no longer believed to play as important a rôle in the matter as was formerly assigned to it. Good hygiene has to a large extent replaced climate. A health resort where a patient can find comfortable quarters, congenial company, plenty of diversion, and where favorable climatic conditions, such as abundant sunshine, absence of disagreeable winds, dust and sudden weather changes, encourage outdoor life, is to be recommended. The climate does not cure; it is an important help in the treatment of the disease. Some patients, especially elderly people and those suffering from nervous, cardiac or bronchial affections, fare better at lower altitudes; but higher altitudes, with the stimulating effects, deep respiration and active use of the lungs which they induce, often offer many climatic conditions favorable to outdoor life and hence of great benefit in the treatment of the disease. The dry, pure air and abundant sunshine of many of the well-known mountain health resorts are very favorable climatic helps. Moreover, the smaller temperature ranges of mountain and marine climates are also helpful. In many, if not in most cases, any change of climate is beneficial, but especially so if such a change is accompanied by the favorable conditions just enumerated. Ocean air, although damp, is beneficial to many patients because of its purity, its salinity and its small temperature ranges. Hence an ocean voyage, with its relief from unsanitary or harmful occupations, may be an excellent restorative. Results obtained in the treatment of tuberculosis by climatic change vary through a wide range. The reasons for such discrepancy are to be sought in the difference in the stage of the disease treated, and in the habits, food, and mode of life of the patients.

Pneumonia. Pneumonia is found almost everywhere, in the tropics probably quite as commonly as in colder latitudes, and at high altitudes as well as at sea-level. A greater frequency of pneumonia generally follows cold, damp weather, with marked changes of temperature, which lower the vitality and are conducive to chills. Hence the disease is most prevalent in the colder months. Among the predisposing causes physical weakness following other diseases, is potent, as are mal-nutrition, and similar debilitating agencies. Severe cold spells are likely to be followed by an increase of pneumonia, especially among elderly persons and children. Negroes who have gone to cold climates are very subject to the disease.

Diphtheria. Although geographically widely distributed, diphtheria is chiefly a temperate zone disease, occurring sporadically or epidemically, however, in tropics and polar latitudes. Like other infectious diseases of the temperate zone, diphtheria is most frequent in the colder months, because the conditions of life are then most favorable to contagion, and because vitality is then most lowered by the prevailing weather conditions. Diphtheria is more common at low altitudes than high.

Influenza. The well-known disease "grippe," caused by a specific organism discovered in 1892, is occasionally very serious, and is apt to be closely followed by epidemics of pneumonia and other diseases of the respiratory organs. Although very carefully studied, there is no certain evidence of any influence of weather, climate or soil upon the disease. The last great epidemic of influenza, in 1890 and thereabouts, is believed by Assmann to have been associated with dry spells and with the carriage of dust. The worst outbreaks have been in the colder season, when indoor life, less fresh air and overcrowding would naturally help to spread the contagion. The fact that those who are suffering from influenza are often not kept indoors explains a general spread of the disease.

Bronchitis. Bronchitis is most common in the higher latitudes, and in the cold months, when the temperature is low and when sudden and rapid variations of temperature are frequent. Dust, blown from the dry surface of streets and the like, helps to irritate the throat and nasal passages. Relief from bronchitis may be found where the climate is warm and uniform; the air soft and balmy; where there are no irritating winds driving the dust to and fro, and where sunshine is abundant.

Rheumatism. Rheumatic affections are as a whole more common in colder than warmer, and in damper than dryer climates, but may be classed under the temperate zone. Exposure to cold and wet, bringing on chills, and sudden temperature changes, especially in damp climates, while not the cause of rheumatism, lower the vitality in such a way that the specific cause may assert itself. In many cases a change of altitude makes no difference whatever; it may, in fact, aggravate the trouble.

Measles and Scarlet Fever. Both measles and scarlet fever are independent of weather and climate except in so far as the colder, more inclement, months involve an unhealthier mode of life, with less attention to sanitary measures. A maximum is usually found in the colder months, when infection is most likely. Measles occur in all climates, but usually most commonly and most severely in temperate latitudes. Scarlet fever is essentially a disease of the temperate zone. Isolation from sources of infection is more important than any climatic control in these diseases, which show very various relations to season, altitude, and race.

Typhoid Fever. Typhoid fever is found in almost all parts of the world. Although common in the tropics, being one of the most generally fatal diseases there, especially among recent European arrivals, it is not, according to Manson, properly classified as a tropical disease. It is very prevalent in the temperate zone, having a maximum frequency in late summer and autumn, and is certainly largely preventable by good sanitation and pure food and water. The germs of typhoid fever are killed in a few hours under direct sunshine, and their growth is slow even in diffused daylight. The well-known studies of Pettenkofer, at Munich, showed an inverse relation between the ground-water level and the prevalence of typhoid, but this appears not to be a universal relation. The view formerly held regarding a connection between temperature and humidity and typhoid epidemics has now generally been abandoned.

Whooping Cough. Whooping cough is more prevalent in temperate and cooler climates, where the temperature changes are marked and where the respiratory organs are most affected, and is rare and less severe in warmer latitudes. But the absence of whooping cough is doubtless often to be explained on the ground that it has not been imported, rather than on any direct climatic basis. Although commoner and more severe in the cooler months, epidemics may occur at all times, without relation to altitude. Croup, also, prevails chiefly in damp, cool weather, with sudden changes.

Cholera Infantum. Among the summer diseases of the temperate zone, cholera infantum occupies a very prominent place. It increases with rising, is at a maximum with maximum, and decreases with falling, temperatures. The greater and more continuous the heat, the more general is the disease. Cool spells check it immediately. It is more common in the overcrowded and overheated quarters of the city than in country, and may be greatly checked by the use of pure milk and fresh food.

Hay Fever. The specific cause of hay fever has been much debated, but is generally regarded as vegetable pollen of some sort. The particular kind of pollen may differ in different cases. The irritation is naturally confined to the season of plant growth. Relief may generally be secured by seeking a higher altitude, where the cause of irritation is absent, and where the air is pure and clean. Sea voyages, also, are beneficial.

Polar Zones: General. In severe cold the vitality of the body is lowered; the pulse slackened, and the ability to bear hardships decreased. The surface of the body cools first; the blood circulates more slowly; the surface blood vessels contract, and the blood then becomes internally congested, the lungs and heart may be affected and in extreme cases death results. The danger of freezing is naturally greatest in the case of the hands, feet, ears and nose, which are most exposed and can least well be kept warm. The skin may swell, become thick and hard, and break open. The power of resistance to extreme cold depends on the physical condition, clothing, food, exercise, exposure to sunshine, dampness, wind, and other factors. Low temperatures are much more easily borne when there is no wind and when the air is dry. Temperatures of 20° F. below zero, or lower, are described as comfortably warm in polar latitudes if no wind is blowing. The feeling of cold is increased by hunger, and rheumatic people usually suffer most.

The physiological effects of polar cold and darkness have been fully reported upon by Arctic and Antarctic explorers, but the recent expeditions, on which very careful attention has been given to picking the men, as well as to their health, diet, exercise and general hygiene, have shown much less marked effects than did the earlier expeditions. Among the effects which have often been observed are a weakening of the senses of taste and of smell, as a result of congestion and over-secretion on the mucous membranes; depression, apathy and sleepiness, often followed by nervous excitement and even in some cases by insanity; anæmia; tendency to digestive disorders and dyspepsia; constipation or diarrhœa; greatly lessened perspiration; fading of hair and beards. The monotony of the polar night is depressing to a degree. Thirst has been one of the greatest plagues of Arctic explorers in the past. The result of a large evaporation from the lungs into the dry, cold air, thirst is a characteristic of the deserts of snow and ice as it is of the deserts of sand. The relief of this thirst by eating snow is dangerous, for it leads to inflammation of the throat, and to digestive and bowel troubles. Moreover, such relief is but temporary.

Life is hard in the polar zones. Deaths by drowning in gales at sea; by freezing, and in snowstorms, are frequent. Yet, on the other hand, most of the diseases which have been discussed in this article are rare or absent in the far North. There is a remarkable infrequency of infectious diseases, largely, no doubt, because there is little traffic with other parts of the world. Polar air is very free from micro-organisms; colds are reported as rare or unknown, although changes of temperature are often frequent and large. An Arctic summer, with its long days, crisp, clean air and sunshine offers conditions which are doubtless excellent for many nervous and gastric troubles, and one may predict a considerable development of summer resorts within the Arctic Circle for the pleasure-loving, wealthy and unoccupied persons of the north temperate zone.

Scurvy. Scurvy has been considered a polar disease *par excellence,* because it has, in the past, been prevalent on Arctic expeditions, and is found to-day in northern latitudes. Scurvy is, however, known also in many other parts of the world. It is found under conditions of overcrowding, and of poor ventilation which are natural consequences of extreme cold. Cold is not the cause of the disease, for scurvy is found in warm countries also, but rigorous climatic conditions; poor food, especially the lack of fresh vegetables; over-exertion; depression; lowered vitality by exposure to cold, etc., are predisposing causes. The best preventives of scurvy are good food, an active outdoor life, and mental stimulation. With these precautions and good hygiene, scurvy has almost disappeared among civilized nations.

Climate and Health: general conclusions. The old view concerning the paramount influence of climate upon health is being replaced by the view that good hygiene is of more importance than climate alone. Medical science has done much to stamp out some diseases like small-pox, and it will in time probably largely stamp out others, like malaria, or yellow fever, or even tuberculosis and diphtheria. Man himself, not climate, is being held responsible for the occurrence of this or that disease or epidemic, for its distribution, and for the death-rates resulting from it. Man has lowered the death-rate from disease most wonderfully. He can lower it still further. Vaccination for small-pox; preventive inoculation for plague; antitoxin for diphtheria; good food, pure air and exercise for scurvy; draining swamps and pools and the use of mosquito netting for malaria; pure water for cholera, typhoid fever and dysentery—these are but a few of the methods now employed by man in his war against disease.

The influence of climate is by no means to be discarded as of no account, for it acts, in many ways, both directly and indirectly, has been shown in this article. The newer view regarding the influence of a change of climate as a preventive or restorative is that a change of residence, habits, occupations, food, is usually of more importance than the change in atmospheric conditions. If pure air, good food, freedom from worry; time for rest; proper exercise, outdoor life and a congenial occupation are provided, many bodily and mental ailments will yield to the treatment. Climate is to be considered, because it affects our bodily comfort; it may be dull, rainy and cheerless, or bright, sunny and exhilarating; it may tend to keep us indoors, or it may naturally tempt us to go out. Thus some climates will naturally be avoided, and others sought out, and the choice of a suitable climate will depend upon the disease to be dealt with. As a recent writer has well said, climate may "play an important part in the curative process, but the climate of certain localities does not possess any peculiar properties which act as a specific on certain diseases."

Geographical Excursions in the Neighborhood of Philadelphia

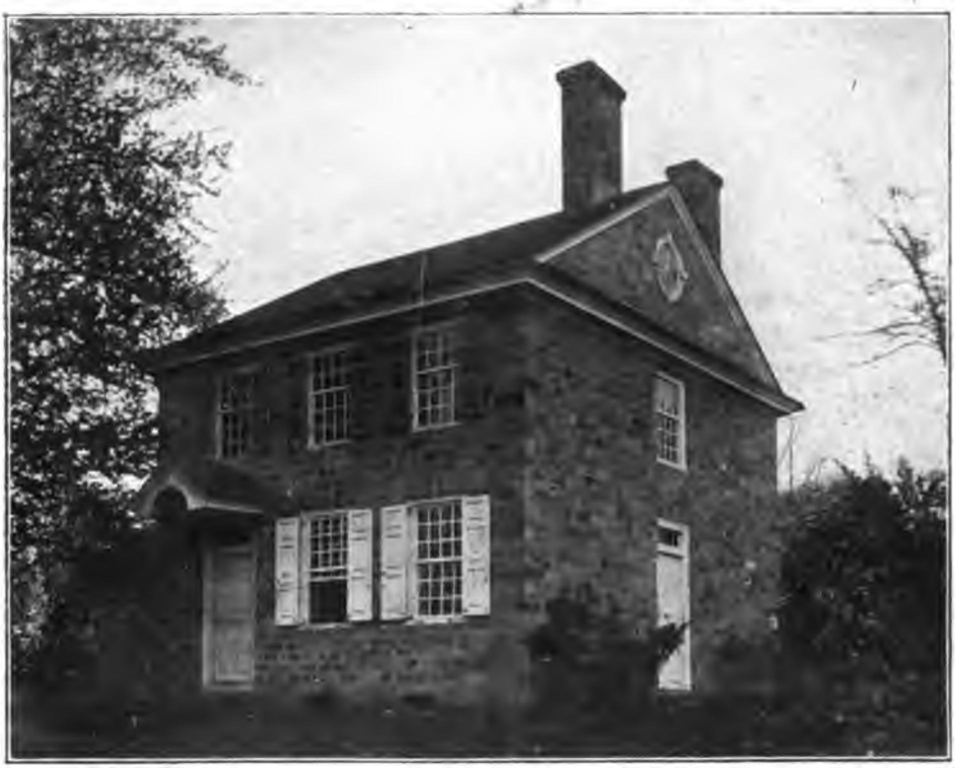
JOURNEY I.

Coaching Trip to Valley Forge and the Home of Audubon on the Perkiomen

In accordance with the plans announced for the excursion the members of the Geographical Society of Philadelphia, who were able to take the trip, left Philadelphia at 8.36 a. m. via the Reading Railway for Norristown, where brakes were waiting at the station. The drive westward over the excellent roads of Montgomery County was made enjoyable by the pleasing landscape of rolling country dotted with frequent patches of forest, stretches of cultivated fields, well-kept farms and attractive, thrifty homes. The winding Schuylkill was in sight during most of the drive.

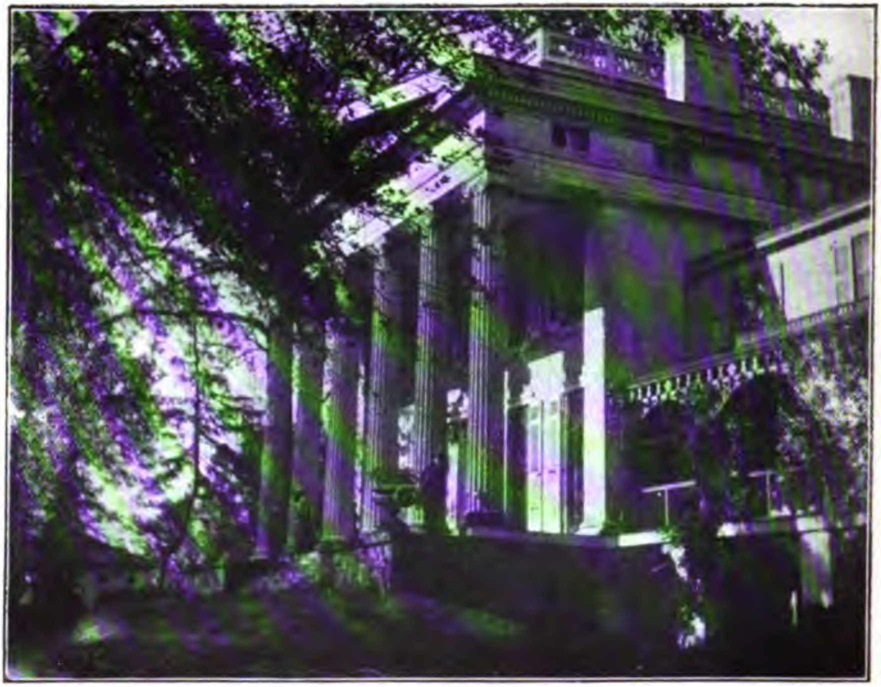
At Port Kennedy the old limestone quarries with their kilns were picturesque, and the new quarries with large asbestos and magnesia works were interesting. In the old quarry at Port Kennedy is a famous cave where the bones of many extinct animals have been found. The fossils from this cave were studied and described years ago by Dr. Leidy and later by Professor Cope and Mr. H. C. Mercer.

The road from Port Kennedy westward partly skirts the river, and in a very short time approaches the Revolutionary Camp Grounds at Valley Forge. It is no sham sentiment that causes one to approach the scene of Valley Forge with feelings of patriotic emotion. It is a Mecca to Americans, second only to the Old State House in sacredness. The tall obelisk that stands over the grave of Captain John Waterman, of Connecticut, first attracted attention; next the Washington Memorial



WASHINGTON'S HEADQUARTERS AT VALLEY FORGE.

(Photograph by Mr. Wm. C. Stevenson.)



Baker House.
(*By Louise D. Woodbridge.*)

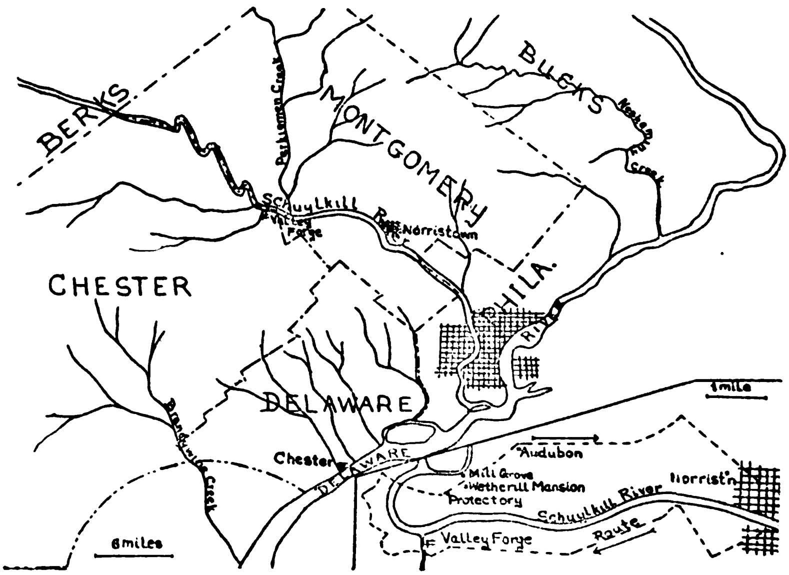
Chapel now building to the right; then the scarcely discernible "Star Redoubt," the old stone house, the headquarters of General Varnum; then the hump of Fort Huntingdon through the trees to the left; after which the line of intrenchments was passed that meanders off from the Schuylkill along the Valley Creek, once commanding the river, the creek, the Port Kennedy road and the old Gulf road. Upon descending the steep hill to the village of Valley Forge, and turning to the right in front of the quaint old Washington Inn of Revolutionary age, Washington's headquarters was reached.

Here the party made its first halt. Formerly an entrance fee was exacted, but that was abolished when the State took the park in charge. The old stone house and the relics require no explanation, but usually upon such a trip some member of the party is delegated to recall the events of 1777-78, that the associations of the place may lose none of their significance.

Mounting the coaches after this stop, the party proceeded westward to the old Nutt road; and then eastward, crossing the Schuylkill at Pawling's bridge, and drove along the Egypt road, the name of which is suggestive of the alluvial fertility of this great curve of the Schuylkill River where it is joined by the Perkiomen. Passing the Protectory, the institution for the education of orphan boys of the Roman Catholic Church, the brakes then turned into the old, but still imposing gateway of the beautiful Wetherill mansion, known as the Fatland mansion, once the architectural glory of Montgomery County, charming now, but pathetic in its decay. The original house was built, as stated on the date stone, in 1760, by Charles Vaux, a Free Quaker, of whom it is said that he had the honor of entertaining General Washington from Valley Forge at breakfast, and General Howe from Philadelphia at supper on the same day.

The dearest association centering about the old mansion is connected with the English family, the Bakewells, who lived there early in the last century. Here Lucy Bakewell met and entertained the young Frenchman, John James Audubon. In her "Life and Letters" Mrs. Audubon quotes most naively from the young man's diary in which he tells the story of his first visit to Mr. Bakewell. Mr. Bakewell was away and his daughter was his substitute. Audubon writes, "It was here that I met my dear Lucy, who afterwards became my wife." And he ventures to record that, "I think she was not perfectly indifferent to me."

Luncheon was taken on the great porches, in the dining-room and on the lawn, after which the party resumed its trip, driving completely around the mansion, took one last whiff of the old boxwood, and drove out the west gate and proceeded a short distance to the entrance of the Mill Grove farm. The route passed the neat little white church built by the grandmother of the present owner of Mill Grove, Mr. W. H. Wetherill, whose appreciation of the Audubon association has done much to preserve and enhance its charm, and the brakes then proceeded between the two pillars at the entrance, upon one of which is inscribed, "The First Home in America of John James Audubon." A drive through an avenue of maples



brought the party to the lovely old stone house, covered with English ivy, standing on the height overlooking the beautiful Perkiomen. At the foot of the hill is the old mill; the house, the mill, the cave and walks on the hillside, the stream, all these abound in association with the great nature lover. Here he found "A blessed spot" of which he loved always to think. Here he did much study and painting on what was to become later his great work, "The Birds of America." Audubon states in his "Birds of America" that "It was in that place (Mill Grove), kind reader, that I first saw with advantage the force of parental affection in birds. There it was that I studied the habits of the pewee; and there I was taught most forcibly that to destroy the nest of a bird or to deprive it of its eggs or young, is an act of great cruelty."

A stop at Mill Grove is always a happy one from every standpoint. In return for the generous cordiality of the host and his family, it is a slight favor to register in the Guest Book, which Mr. Wetherill keeps as a tribute to the great naturalist whose memory he loves to honor.

The drive homeward from Mill Grove passed through the village now known as Audubon, the old name of Shannonville having been discarded and the new one bestowed through the efforts of Mr. Wetherill. Later in the afternoon the party reached Norristown, where the train was taken for Philadelphia.

These short excursions are revealing to the members of the Geographical Society some of the charms that lie near at home. Everyone, whether he be much or little traveled, enjoys a due appreciation of the beauty and the historical associations of his own neighborhood. To know and appreciate a small section of the world has a geographic value worthy of cultivation, and it is the purpose of these litle journeys to thus combine pleasure and profit.

Mary S. Holmes,
Chairman of Excursion Committee.

Baron Ferdinand von Richthofen

OBITUARY

Baron Richthofen, the eminent German traveler, geologist and geographer, was born at Karlsruhe, in Silesia, May 5, 1833, studied at the Universities of Breslau and Berlin, and later at the Geological Institute of Vienna, from which place he went to Tyrol to do his first geological work.

Between 1860 and 1872 von Richthofen traveled in Eastern Asia, Malaya, and visited the western United States. His first foreign travel was with the Prussian expedition to eastern Asia under Count von Eulenberg, which he accompanied as geologist, holding the rank of Legation Secretary. It was this expedition which created his lifelong interest in the Far East. He left the Prussian party in Siam and extended his travels through the important islands of Oceanica and through Burmah. In 1868 he went to Shanghai and spent four years in exploring a large part of China, returning to Europe in 1872 to write an account of his travels. His great work on China embodies the results of his exploration.

Soon after his return von Richthofen was made a Member of the Council, later Vice-President and President of the Gesellschaft für Erdkunde in Berlin. In 1875 he was elected to the chair of Geology at Bonn. He was made Professor of Geography at Leipzig in 1883, and in 1886 he was given the professorship at Berlin which he held until his death. In 1902 he was made director of the newly-established Institut für Meereskunde, and in 1903 was appointed Rector of the University of Berlin.

His many contributions to geology and geography include: The Comstonck Lode (1865); Natural System of Volcanic Rocks (1867); Letters on China (1870-1872); China (1877-81); Guide for Explorers (1866); and Aufgaben und Methoden der heutigen Geographie (1886). The work on China was his greatest, and made him an authority on the East. It was at his advice that the Germans selected Kiao-Chau as their Asiatic naval base, and later devoted their efforts mainly to the exploration and development of the province of Shantung.

Baron Richthofen died at his home in Berlin, October 7, 1905. His death means the loss of one of the foremost of the great European geographers.

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Northward Over the Great Ice. Robert E. Peary. New York: Frederick A. Stokes Company, 1896. Two volume.

or all-day outings to nearby places of scenic or historic interest have proven to be a most popular phase of the Society's activity.

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The supply of Volume I, Nos. 1, 2, and 4 is exhausted, and the Geographical Society would be pleased to receive one or all of these issues from members who may be willing to contribute them. The copies should be sent or mailed to "The Geographical Society, Room 314, Baker Building, 1520 Chestnut Street, Philadelphia.'

ERRATA, VOLUME IV, NO. 2.

Title of picture facing page 57 should be Wetherill Mansion, not Baker House. .

Page 57, line 28, for "1760, by Chas. Vaux, a Free Quaker," read "1776, by J. Vaux, a Quaker."

Owing to an oversight the volume pagination—at the foot of pages—was omitted from the January BULLETIN. *This pagination should read from page 49 to 112, inclusive. It is suggested that members insert these page numbers with pen.*

THE BULLETIN
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A Regional and Economic Geography of Pennsylvania

WALTER S. TOWER.

PART I.

Physiography: The Central Province

Location and Extent.

The second division of the State, the central province, a part of the younger Appalachian area, is a region of parallel and converging ridges, and, like the older Appalachians, is a folded mountain region once worn down and again elevated and redissected. The province includes the area between the South Mountains on the east and Allegheny Mountain on the west. (Map, Fig. 1.) The length of the province in this State is about 230 miles from southwest to northeast, and through much of its extent it has a fairly uniform width of about 50 miles. East of the Susquehanna, however, its boundaries converge and it narrows rapidly as it merges into the Pocono plateau on the northeast. The province covers a little over one-fourth of the area of the State, comprising the whole or parts of twenty-four counties. Outside the state limits, the province extends northeast into New Jersey and New York with rapidly decreasing width and prominence; and southwest through Maryland and Virginia to Alabama. Toward the southwest, however, the elevation both of the valley floors and of the ridge crests increases, the latter reaching heights above 3000 feet in West Virginia and Eastern Tennessee. In Pennsylvania the ridges do not often exceed a uniform elevation of about 1800 to 2000 feet above sea-level and 800 to 1000 feet above the neighboring valleys.

The central province is divided into two districts by the long rampart of Kittatinny or Blue Mountain: (1) on the east, the lowland of the Appalachian valley, developed on a broad belt of limestone and slates; and (2) the region of the closely ranged ridges and valleys, lying to the west.

Appalachian Valley—General Character.

The Appalachian Valley, known in different localities as the Hudson, Kittatinny, Cumberland and Shenandoah Valley, was known as the Great Valley to the early settlers in Pennsylvania because of its resemblance, on a much larger scale, to the already familiar Chester or Little Valley. It is sometimes locally known as the Lebanon or the Cumberland Valley. The name Great Valley, however, is particularly fitting, not only because of the great width as compared with the other valleys of the state, but also because of the practically unbroken extent, northeast and southwest through a distance of 1000 miles from Canada to Alabama. With a single exception, the valley throughout its length is separated from the open country of the Atlantic seaboard by the still fairly prominent remnants of the older Appalachian ranges. The single break is in Pennsylvania, where the gap in the South Mountain range, between the Reading and the Carlisle prongs (Map, Fig. 1) allows the valley to open out toward the sea. The Great Valley runs for 150 miles of its length northeast and southwest across this State, somewhat wider toward the northeast, reaching a width of nearly twenty miles; narrower toward the southwest, with a width, near Carlisle, of about ten miles. The southeastern boundary, made by the hills of the South Mountain range, is somewhat irregular; but the northwestern boundary is regular throughout its extent as it follows the almost unbroken wall of Blue Mountain. (Map, Fig. 1.)

The early settlers who came to till the fertile soil of the valley found a broad lowland from 15 to 18 miles wide, which was divided lengthwise into two distinct belts: a belt of limestone lying along the base of the South Mountains, and a belt of slate lying along the foot of Blue Mountain. The line of separation between the two is now straight, now irregular, and is marked, especially toward the northeast end of the valley, by a steep hill slope, or "step," from the higher slate country down to the lower limestone area. The slope recalls at once the boundary walls of the Chester Valley, and more particularly the step between the Lancaster plain and the higher upland level of the sandstone region. As in the other areas, this escarpment is the measure of the differential rate of erosion on the two belts of unlike texture.

The irregularities of the border between limestone and slate are due to the presence of minor creases and wrinkles in the two formations. In the course of erosion the tops of these folds were bevelled off just as the larger mountain-making folds were bevelled by the Cretaceous peneplain. Where there had been arches, small areas of the underlying limestone appear almost surrounded by slate, and where there had been troughs, narrow prongs of slate extend into the limestone. Thus when the region was further dissected the more rapid reduction of the limestone gave the well known "coves." Numerous illustrations of coves occur in different parts of the valley, as near Kutztown, in Berks County, Trexlervile and Jordan's Creek, in Lehigh County, and Middlesex, in Cumberland County. A variation of the cave type is found in numerous "circuses" of limestone, completely surrounded by slate, at some distance from the edge of the belt.

Examples of slate prongs are usually found along with the coves, shutting them off on one side from the main limestone lowland. The most important encroachment of the slate on the limestone area, however, occurs round about Wernersville, in Berks County. There apparent local wrinkling, on a larger scale than was required to produce the coves, has left still unremoved three large, infolded bands of the slate, separated by narrow strips of the limestone. As a result of the presence of the slate areas the limestone lowland is narrowed to a little over a mile in width near Robinsonia, while practically the entire width of the valley presents the characteristic slate topography.

That the conditions producing the coves and the ridges of slate have not been confined to the slate and limestone formations alone is shown by the curious turns in Blue Mountain—as the Big and Little Offsets in Berks County and the larger zigzags in Franklin County near the Maryland line. Exactly the same processes have been at work in these cases to produce the coves in the Great Valley itself.

Limestone Belt.

The limestone of the Great Valley makes the plain along the northern base of the South Mountains. In Northampton County the lowland is about seven miles wide, but varies greatly toward the southwest. Thus it is only three miles wide at the Lehigh-Berks County line, two miles at the Schuylkill, seven miles in Lebanon county, two miles on the Susquehanna, and from there on widening steadily to ten miles as the Maryland line is reached. The plain in any given part shows a marked uniform level, varying from 400 feet in the northeastern part to about 700 to 800 feet in the southwestern part. The relief is slight over most of its extent, with few hills rising more than 500 or 600 feet above the general valley level. A noteworthy exception to the rule, however, is Quaker Hill, north of Bethlehem, a steep rounded knob of hard sandstone, apparently an outlier of the South Mountains, standing out boldly 200 feet above the surrounding country.

The plain is intersected in every direction by the gently sloping shallow vales, mainly destitute of running water, so characteristic of well reduced limestone areas. A few, however, are occupied by small streams, tributary to the main streams flowing transverse to the valley. For here, as in the Chester Valley, the favorable limestone belt is not traversed by any main longitudinal stream. The main transverse rivers, the Lehigh, the Schuylkill and the Susquehanna, have entrenched themselves to a depth of 50 to 100 feet in somewhat opened out valleys. The larger tributaries show the same entrenchment in their lower courses, where, as a rule, the greatest relief in the region is found. Lehigh Creek, flowing almost entirely on the limestone area is a good illustration of the revived streams, flowing in an entrenched meandering course, in a narrow valley 100 feet deep. Jordan's Creek, nearby, and Maiden's Creek, in Berks County, are other examples of the same sort.

Perhaps the most striking feature of the drainage of the limestone lowland is the scarcity of surface streams, at once apparent in the field, possibly even more distinct on the maps of the region where a large area can be viewed at a glance. The condition is a parallel to the condition seen in the Chester Valley. The many sink holes pitting the surface show the presence of numerous large limestone caverns whose roofs have fallen in to give the sinks on the surface. Through these sinks much of the surface water of the region is drained to the underground courses, along which it flows to issue as springs in the bed of the deeper valleys. Some of the older caverns are now dry, the streams which made them having found other channels. Many of these deserted courses are now choked and filled with impure clays, from which were derived the "pot deposits" of hematite iron ore, formerly one of the most important sources of iron ore in the country.

Slate Belt.

The other division of the Great Valley, the slate area, runs along the base of Blue Mountain throughout the entire length of the valley. The width of the belt varies, being generally somewhat wider than the associated limestone, though it usually does not exceed ten miles. When viewed from the crest of Blue Mountain, the slate country appears to be a great level plain. And in reality it is a plain, theTertiary, or Harrisburg peneplain, whose once continuous surface is now trenched by the many stream valleys. The hill tops at the northeastern end of the valley rise to a general level between 700 and 800 feet. In Lehigh county the level is nearer 900 feet. While in the southwestern part of the valley the slate belt does not rise above the higher levels of the limestone lowland, and except where it is followed by a stream, as in the case of the Conococheague, south of Chambersburg, the boundary between the two is not marked by any distinct erosional escarpment. The uniformity of level of the slate hill uplands is best developed near the Susquehanna at an elevation of 500 feet, from which locality it received the name Harrisburg peneplain.

The upland level is much dissected over most of the area by the many streams which have cut their valleys to depths of 100 to 200 feet. The side slopes of the valleys are steep and often rough, though the rapid weathering of the slate has tended, in places, to smooth off the slopes. The value of the differential rate of erosion between the slate and the limestone areas is perhaps best shown along the course of a transverse stream. In the slate country the main streams receive frequent tributaries, flowing in valleys which present sharp ascents to the upland level, but as they issue into the limestone areas they receive few tributaries, and flow between low, gently rolling divides, with gradual ascents. A typical example of the fewer tributaries from the limestone area is furnished by the Conococheague, which flows for about ten miles along the immediate boundary between the two belts. In that distance it receives ten branches from the limestone and fifteen from the slate; but in the streams from the limestone area only four were themselves branched, as against ten of the streams flowing from the slate area.

Drainage of the Valley.

The chief characters of the Great Valley streams have already been noted, the transverse entrenched courses of the main rivers, and the distinct types of drainage developed on the two belts of different texture. It remains only to note the peculiar course of Conodoguinet Creek, flowing north along the slate belt to enter the Susquehanna opposite Harrisburg. It is the clearest example of revived mature drainage to be seen anywhere in the valley, flowing as it does in an extremely meandering course, entrenched in its lower part to a depth of nearly 200 feet. The valley is still narrow, with only small flood plain scrolls yet developed. The upland spurs present the normal unsymmetrical form, steeper on the up-valley and more gently sloping on the down-valley sides. But the meanders themselves and the associated spurs show long tangents or reaches between the distinct bends, quite unlike the usual type of sweeping curves enclosing pear-shaped spurs. There are other streams in the valley flowing in entrenched meandering courses, but none of them show a similar pattern of meanders, hence there is little reason to suppose that the unusual pattern is the result of structure. Nor is it the result of variation in texture, for the stream is flowing on a single formation. It seems probable that the explanation lies in the conditions preceding and associated with entrenchment, but just what these special conditions were is not entirely clear.

Summary.

The Great Valley, a part of the Appalachian Valley, has been opened out between the higher bounding ridges, on parallel belts of limestone and slate, each of which has given a characteristic sort of topography. The limestone makes a distinct lowland, with slight relief, gentle slopes and few streams. The slate area stands higher, separated by an escarpent due to different rates of erosion, with greater relief, steeper slopes and many streams in narrow valleys. Each area represents in its uniform upland level the development of the Tertiary lowland, below which both the main transverse rivers and their tributaries have entrenched themselves in the narrow valleys of the present cycle.

Ridges and Valleys.

The second division of the central province, the region of linear ridges and narrow valleys, represents the northeastern end of the younger Appalachian ridge belt, extending southwest to Alabama. The eastern border of the district is made by Kittatinny Mountain (Map, Fig. 1), or as it is variously called in response to local geography, First, Blue or North Mountain. It is a monoclinal ridge, making a rampart-like wall of rock from 1200 to 1600 feet high, even-crested, steep-sided, with a gentler slope toward the north and often capped with a sharp south-facing cliff 100 or more feet high. In its extent from the Delaware River to the Maryland line the mountain makes a sharp barrier between the ridge belt and the Great Valley, a barrier unbroken except by the coves in Franklin County and by the narrow gaps made by the various streams as they cross it on their way to the sea. The western edge of the district is marked by the steep escarpment of Allegheny Mountain, or Allegheny Front (Map, Fig. 1), as it is often called, which extends in a sweeping curve from the Maryland line in Somerset county almost to the northeast corner of the State. It acts as a similar barrier between the central and the plateau provinces, except in the places where it is crossed by the northwest branches of the Susquehanna River or where its crest has been lowered by the streams which flow down the Front. Between these two bounding ramparts lies the great series of parallel and converging ridges which sweep across the State in a gentle curve over the anthracite coal fields, to become fainter and fainter as they merge into the Pocono plateau on the northeast.

For the purposes of detailed study the district is divided into two parts (Map, Fig. 1): (1) The area west and southwest of the Susquehanna River, which may be called the Juniata region, from its main river; and (2) the area east of the Susquehanna River known as the anthracite coal region.

Juniata Region.

The Juniata region, so called from the fact that it is drained principally by the Juniata River and its tributaries, is very nearly equal to the southeast province in extent, comprising somewhat more than half the area of the ridge belt. Its surface presents a labyrinth of parallel and converging mountain ridges, with steep sides and sharp crests, separated by narrow longitudinal valleys. The importance of folding in producing the ridges may be seen in the fact that with three exceptions—Cove Mountain, in Perry County, and Sideling Hill Mountain and Terrace Mountain, in Huntingdon County—they are all made by repetitions of the same massive sandstone formation known as the Oneida-Medina, consisting of three layers, a coarse conglomerate and a red and a white sandstone. Similarly repetitions of the various softer limestone and shale formations have given rise to the intervening longitudinal valleys.

The ridges in different parts of the area rise from 1600 to 2000 feet above the sea and about 500 to 1000 feet above the neighboring valleys. Some minor ridges are lower, while others larger, reach greater heights, as in the loop from Evitt's Mountain to Dunning Mountain, in northeastern Bedford County, where the crest is nowhere below 2400 feet in a distance of over six miles. Along any single ridge the crest is usually unbroken except by the narrow V's of the wind gaps or the deeper gashes of the watergaps. The ridges continue often for many miles at a nearly uniform level, above which occasional rounded knobs rise 100 or 200 feet higher. When the region is viewed from any prominent vantage point the nearly even line in which the mountain crests stand in profile against the sky, giving the impression of great walls, is the most striking feature of the landscape.

But when viewed from a point in the valley of any stream, the surface appears to be made up of irregularly placed hills, with soil-covered slopes, sometimes forested, sometimes cultivated. From the top of any one of these hills are seen many others of about the same appearance and the same height. Were the trench-like valleys to be filled to the general level of the hill tops, any separate valley would appear as a plain, but interrupted here and there by higher residual hills and ridges. This dissected plain represents the unfinished lowland of the second cycle, coresponding to the Harrisburg peneplain of the Great Valley slate area. But here the lowland was less perfectly developed; in fact, it was practically absent in some places, because of the presence of certain hard layers. It stands at a higher level, generally over 1000 feet, because held up by the hard bounding ridges across which the streams had to cut.

Ridges.

In both directions, northeast and southwest, the valleys are hemmed in by high rock walls, the linear ridges of the upturned massive sandstone, across which the only outlet for many miles is through the deep gorge-like water gaps, or over the less convenient low sags of the water gaps, as McKee Gap and Dry Gap, in Fig. 2.

If the district could be viewed from some height which would show the whole area at a glance, as on the Map, Fig. 1, the ridges would appear to be arranged in three general groups of parallel, converging and zigzag mountains. The first group lies on the extreme southeast, between Blue Mountain and Tuscarora Mountain. The second group, lying to the west, appears like three narrow, upturned and bottomless canoes moored side by side, but projecting each beyond the succeeding one. And the third group covers the remaining complex series of ridges from Jack's Mountain on the east to Bald Eagle Mountain on the west. The ridges making up these groups may be divided on the basis of their structure into three classes: (1) Monoclinal ridges, with their variations in the zigzag and the terraced mountain; (2) anticlinal mountains; and (3) synclinal mountains.

Monoclinal Ridges.

When seen in cross profile from a distance, a monoclinal ridge, like Tuscarora Mountain, as it rises above the surrounding country, appears like a series of knobs, one behind the other, increasing in height with each successive step until the level of the crest is reached. Nearer views of the ridges in cross section, as seen, for example, in the water gaps, reveal the layers of the ridge-making strata all dipping in one direction, hence monoclinal, and show that the angle of the dip of the strata largely determines the shape of the individual ridge, the character of its slopes and often the height of its crest. Ridges formed by gently dipping strata show an unsymmetrical form. They rise gradually on one side where the surface is held up by the level of the hard layers, and drop off sharply from the crest on the other side, where undermined by the rapid erosion of the underlying softer rocks. The edges of the outcropping strata often break off in a line of cliffs surmounting the ridge, the height of the cliff depending on the thickness of the particular stratum at that place, and whether it is all exposed. As the dip increases, however, it is evident that the two slopes will more nearly approach the same character. When it reaches the vertical the whole outcropping edge of the beds makes the crest, and generally symmetrical slopes are worn from the adjoining strata. Blue Mountain shows the unsymmetrical form with a gentler slope to the north, steeper to the south, and a crest often capped by a line of cliffs. Across the ridge belt toward the northwest the dip of the strata becomes generally steeper, until in Bald Eagle Mountain it reaches the vertical and gives the type of ridge with practically symmetrical slopes.

The Juniata ridges ,though generally described as even-crested and steep-sided, are not always of the simple monoclinal type. The group of ridges on the southeast answer this description, though the symmetry, form and height of crest vary with the individual ridge. But some of the ridges farther to the northwest are found to have a main crest and one of the side slopes interrupted by a lower secondary crest or terrace. (Fig. 2, A.) This modification of the monoclinal ridge is the result of a variation in the nature of the ridge-making formation. In the southeastern group of ridges it is a single solid formation, but toward the north it is divided into an upper and lower massive layer, separated by a band of softer shales.

Thus, when the formation outcrops, the upper hard member is the real ridge maker, from the crest of which a slope is developed, on the band of shales, down to the lower hard member. The latter, more resistent than the shales above it, has not retreated so fast in the process of developing the slopes, and stands out as a terrace below the level of the main crest. As the dip steepens, the terrace appears relatively higher and higher, until, as the angle approaches 90 degrees, both hard members are practically crest makers, and the so-called double-crested mountain results. Bald Eagle Mountain is usually taken as the only double-crested mountain in the region, and even it is a poor example, since varying inclinations of the strata make the crests of the two hard members frequently of unequal heights. There are, however, numerous examples of the simple terrace. One of the best examples is found on Tussey Mountain, in Blair County, where the terrace is very distinct about 500 feet below the level of the main crest and 2500 feet distant from it. Others are found on Dunning Mountain, nearby, on Stone and Canoe Mountains, along the Juniata Valley, on Cove Mountain, at the mouth of the Juniata, and on Loop Mountain, in Fig. 2.

Parallelism of Ridges.

The nearly even crests and the great linear extent are often spoken of as the most striking characteristics of the ridges. Along with the linear extent might be included the close parallelism to other ridges which they often show. This uniformity of direction in ridges made by repeated outcropping of the same formation is perhaps best explained by analogy. The different strata in each fold have been likened to the annual layers in the trunk of a tree, which, when a log is cut across, may be seen arching over each other. But if the log is sawed with the grain, as in making planks or boards, the edges of the layers are exposed in parallel lines in corresponding order to the left and to the right of the center. The same thing has happened in nature. The strata arched up in great folds made the logs, and they were then planed down to a general level in which the beveled edges of the different strata correspond to the grain of the wood. When the region was again dissected after uplift, the opposite outcrops of the hard strata stood up in parallel ridges. Evitt's and Will's Mountains, in Bedford County, and Nittany and Brush Mountains in Center County, are roughly parallel for several miles. But the best example in the State is that of Blue, Second, Third and Peter's Mountains, just east of the Susquehanna. (Map, Fig. 1.)

The parallelism of the ridges, though often distinct for several miles, is, however, nowhere perfect, for sooner or later they are almost certain to converge and join with each other or with different ridges either at one or at both ends. Here again to return to the log analogy makes the explanation easier. If the log had been sawed diagonally across the grain instead of parallel to it, the annual layers would have appeared, not perfectly parallel, but converging toward one end or both ends, to loop around and unite. These conditions were reproduced in the folds by the pitching of their axes now up, now down, so that the outcropping layers, after being bevelled off, converged and looped around in the outline presented by almost every set of ridges in the region. The high or low angle of pitch for the individual axis determined whether the convergence should be rapid or general. Loop and Lock Mountains (Fig. 2), in Blair County, are good examples of the former, and Jack's and Standing Stone Mountains are good examples of the latter.

Where two terraced mountains converge, if the terraces are facing each other, they unite first inside the loop and fill in between the crests with a broader shelf at their own level. But if the terraces face away from each other, they curve around, outside the loop of the crests, and after uniting may project several miles beyond the main ridge. Terraced mountains of the latter type have been likened to ships with their keels uppermost, and from this resemblance have often been called "keel" mountains. Examples of the convergence of terraced mountains and the uniting of terraces may be seen at the east end of Kishicoquillis Valley, in Center County, on

Short, Brush and Nittany Mountains, in Center and Clinton Counties, and on Loop Mountain (Fig. 2, A), in Blair County.

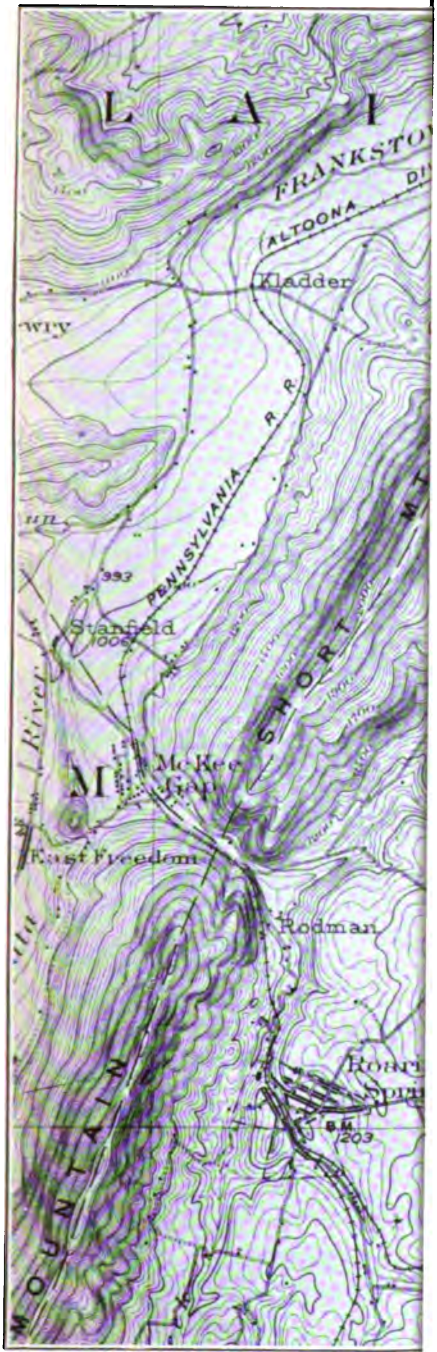
Zigzags.

If, now, two ridges of a pair converging in one direction, each converge with different ridges in the opposite direction, there will result a continuous ridge looping back and forth, first in one direction, then in the other, the alternate reaches of which are roughly parallel. (Fig. 2.) To this type of ridge the name *zigzag* has been applied, and accordingly as the original folds were broad and gently pitching, or narrow and steeply pitching, the zigzags are long and wide or short and close together. The best example of the class is the double series of ridges at the western end of the anthracite coal region (Map, Fig. 1), where the ridge crests run west and loop back to the east successively, as Catawissa and Line, Manhantango and Berry, and Peter's and Second Mountains. Following the same course, essentially parallel to the first, and contained within them, is the second set, Big and Mahanoy, Coal and Lick, and Stony and Sharp Mountains. Another good example is in the Buffalo or Seven Mountains in Center and Clinton Counties, where a group of narrow folds, steeply pitching, has given a series of short zigzag ridges with seven loops to the northeast and seven to the southwest. (Map, Fig. 1.)

What may be called a variation of the zigzag ridge results when the axis of one fold rises into the air at the same time that the axis of an adjoining fold pitches beneath the surface. In such a case the ridge of neither fold loops back on itself as in the simple converging, or zigzag mountains, but is joined to the other by an offset, or perhaps more properly a *cross set* ridge, and continues on in the same general direction as before. The only clear example of the sort is afforded by Dunning and Evitt's Mountains, in Bedford County, which are joined by a cross set ridge six miles long.

Anticlinal Mountains.

The second or anticlinal type of ridge is represented in



From Hollidaysburg Quadrang

A—Synclinal terminati

the middle group, which consists of three mountains (Map, Fig. 1), resembling upturned, bottomless canoes. The most southerly one, the largest, is made by West Shade and Black Log Mountains, for an extent of 45 miles from northern Fulton County to the Juniata River. The middle one, Blue Ridge, has a length of about 30 miles along the Mifflin-Juniata County line. And the third, East Shade Mountain, about the same length, extends from Lewiston, on the Juniata, to within a few miles of Selinsgrove, on the Susquehanna. They represent the cores of once greater arches whose axes pitched down both to the northeast and to the southwest.

During the process of peneplanation the bevelling of the strata went just far enough to uncap the arches in the ridge-making hard layer, between the opposing outcrops of which was exposed only a small belt of the underlying softer strata. Hence, when the region was redissected, only a very narrow valley could be opened out; the ridge crests were close together, as they are seen to-day; and, converging in both directions, they terminated in the sloping ends or "noses" typical of anticlinal folds. It is this sloping character of the anticlinal noses which gives the strong resemblance to upturned canoes. Though the three ridges of the middle group are practically the only well marked examples of the anticlinal type, there are numerous instances in which greater bevelling of folds pitching down sharply in but one direction has left the anticlinal terminations, as the sloping noses at the northeast turns of the Seven Mountains in Clinton County, on Loop and Brush Mountains, in Blair County (Fig. 2 B), and on Dunning Mountain and Warrior Ridge, in Bedford County.

Synclinal Mountains.

The synclinal type of mountain is well shown in Nittany Mountain, in Center County, and less perfectly in the Broad Top area in Huntingdon County. The chief differences from the anticlinal or monoclinal type are the broader crest, which shows a shallow trough-like form, at once expressive of the synclinal origin; the steeper outer slopes; and the high abrupt termination, the synclinal "knob," resembling the prow of a ship. (Fig. 2, A.) These knobs result from the rise of a synclinal axis, carrying the hard crest maker high into the air. The rapid erosion of softer, lower strata, gives the edges of the sandstone broken off in a line of cliffs, with a steep slope down to the level of the valley. Prow-like knobs, without the associated trough-like crests which make up the true synclinal mountains, are found in many parts of the region. The crests of Terrace Mountain and Sideling Hill Mountain join in a magnificent knob which rises from the right bank of the Juniata River a few miles below Huntingdon. Parnell's and Jordan's Knobs, in Franklin County, rise abruptly to heights of 2000 feet, overlooking the broad lowland of the Great Valley. And the Seven Mountains, which afforded the examples of anticlinal noses toward the northeast, project into Center County in a similar series of synclinal knobs ending abruptly toward the west.

The idea is often met with that in a region of folded mountains of the Appalachian type the processes of denudation tend to give synclinal mountains and anticlinal valleys. But in Pennsylvania, at least, the evidence in the field does not support this view. The conditions show characteristically anticlinal mountains and synclinal valleys, or, as is far more common, both mountains and valleys of monoclinal structure.

Valleys.

The same folding of the strata which gave repetitions of the ridge-making sandstone also gave similar repeated outcrops of the softer shales and limestones on which the present intervening valleys were developed. Though the ridges receive first consideration as the most prominent feature of the topography, the valleys are no less important. It was by the development of the valleys that the ridges were left in relief, and by their continued more rapid reduction the ridges may actually be given a greater relative height. The valleys are as a rule but a few miles wide and often many miles long, with the individual characters depending largely on the local nature of the valley-making rock, and the extent to which it is enclosed by ridges.

Some of the valleys show the former development of a lowland, now broken into many separate hills of nearly uniform level by the narrow ravines of the entrenched streams, a condition closely analogous to the conditions in the Great Valley slate belt. The general upland level in the valleys, however, is not uniform over the whole area. Near the larger streams, even though once well developed, it is now often so far dissected and modified by later erosion as to become no longer easily recognizable. Again, where the ridges bounding the valley are high and closely ranged, the lowland was never well developed. Along the Juniata, for example, the valley floors are traversed by ranges of hills, which, though low in comparison with the main ridges, do not suggest any marked uniform level. In Perry County, on the eastern side of the district, ranges of hills of sandy shales reach heights of 200 to 400 feet above the surrounding country, apparently the representatives of minor residual ridges which were never completely reduced. In Nittany and Kishicoquillis Valleys and in Morrison's Cove (Fig. 2), on the other hand, all limestone valleys, and almost in the heart of the ridges, the lowland was well developed and is still distinctly preserved, recalling in appearance the limestone lowlands of the Great Valley and the Lancaster plain. Thus, in general, the rule holds true that the valley lowlands of the Tertiary level were best developed in the wider, softer belts and on the limestones, and least perfectly developed on the narrower soft belts and on the shales.

Like the ridges, the valleys may be divided, according to the structure on which they have been developed, into three classes—monoclinal, anticlinal and synclinal. In the case of the valleys, however, the difference in structure alone has relatively little effect on the individual character. Most of the valleys of the region are of the monoclinal type, the best example of which is, of course, the Great Valley. Bald Eagle Valley is also good; lying between Bald Eagle Mountain

(Map, Fig. 1) and the Allegheny Front, it rarely exceeds one mile in width in a nearly straight course of over fifty miles from near Altoona to Lock Haven.

Anticlinal valleys are associated with the central group of anticlinal ridges. They are narrow, too shut in to be inviting, and, generally formed in these cases on a slate floor, are not very level. Black Log Valley, between Black Log and West Shade Mountains, is the best example. It is about 45 miles long, one and a half miles wide, and nearly straight throughout its entire length. It is enclosed at both ends by the convergence of the bounding ridges, with no outlets except near the southern end, where the high walls are broken by the narrow gaps of Black Log and Shade creeks.

Synclinal valleys are best represented in those enclosed by ridges uniting in synclinal knobs, often called canoe valleys or "coves." The term cove is, however, also sometimes applied to valleys heading up to anticlinal noses. Horse Valley, opposite Chambersburg, and Bear Meadows, north of Huntingdon, are good examples of synclinal valleys.

The most striking features of the valleys, whether of one structure or another, are their linear extent and shut in character. Bald Eagle and Black Log Valleys, already referred to, are typical. Kishicoquillis Valley, between Stone and Jack's Mountains, in Mifflin County, 53 miles long and four miles wide, is completely isolated except for the single outlet, Logan's Gap, near Lewiston. Tuscarora Valley is 50 miles long by five miles wide. And Path and Nittany Valleys are both over 30 miles long and from two to five miles wide, with no easy outlets except through an occasional water gap or over a higher wind gap.

The sharp contrast between the linear extent and the width of the valleys is a direct result of the attitude of the strata, giving broader valleys where the strata are gently inclined and narrower valleys where steeply inclined. These diverse results are best illustrated by a comparison of the narrow valleys, as Bald Eagle, Black Log and the others, where the strata are steeply inclined, with the region lying in eastern Snyder and Union, and in Northumberland and Montour Counties, known as the open region of the middle Susquehanna. It is a fertile, open country, with a somewhat broken surface. The highest elevations are residual ranges of hills rising 500 feet above the surrounding level, but often not too steep to prevent cultivation. The region is in reality but a widening out of the valleys which occur to the southwest, due to a flattening of the inclination of the strata and the consequent broader outcrops of the softer valley-making formations.

Drainage.

Like most limestone regions, subject to abundant rainfall, the central valleys show the presence of caverns, sink holes and underground systems of drainage. The locality known as Sinking Spring, in Tyrone Township, Blair County, furnishes a good example. Arch Spring Creek, rising on slightly higher ground toward the southern end of the valley, flows for about five miles on the surface, only to disappear through a large sink hole and flow underground for a mile, the former channel on the surface remaining dry. Two other smaller neighboring creeks follow the same example, one of them having an underground course for over three-fourths of a mile.

The so-called "hollows" of the limestone valleys are unroofed or sunk-in ancient caverns. Their origin is apparent from the shape, unlike that of valleys ordinarily eroded by surface streams, and from the fact that many of them are not only dry, but also studded with sink holes. In Center County a "hollow" locally known as "Big Hollow," near Houserville, has been described as having a distinct course for nearly five miles, with banks sometimes fifty or a hundred feet high, and often steep and precipitous. An extensive area slopes toward the ravine, but there is no record of water ever having flowed in it. Numerous sink holes along its course indicate that it marks a main line of underground drainage. Elk Run, at the foot of Bald Eagle Mountain, near Tyrone, flows in a deep trench, which apparently represents a series of unroofed sink holes and caves. Henewall's Cave, near Waynesburg, in Juniata County, is said to be "of vast dimensions," while a cave in Gregg Township, Center County, is described as "sufficiently large to allow navigation in a large rowboat."

As might be expected from the occurrence of so many caves and underground water courses, the region is well supplied with springs where the streams issue again, either on the lower hill slopes or in the deeper valleys of the larger streams. Blue Spring, near the bank of the Juniata River, in Porter Township, Huntingdon County, is believed to represent a large part of the underground drainage of the region to the south. Bedford Spring has given the name to a village, and its waters are well known because of their mineral qualities. Near Bedford are several other springs, as sulphur and magnesia springs, both of which issue directly from the limestone wall surrounding the little valley in which they lie. The springs at Spring Hope, Spring Meadow, Bedford Spring and many other places have volume enough so that they have been used to supply power for small mills. Bellefonte, in Center County, is so named from the "beautiful spring" which occurs within its limits, and which for many years has furnished water for the town, with a discharge estimated at about 14,600 gallons per minute.

The rivers of the district belong to two systems—the Susquehanna and the Potomac. Only the extreme southern part, in Bedford and Fulton Counties, however, is drained by the short creeks tributary to the Potomac, heading but a few miles north of the State line. All the main drainage is accomplished by the Juniata River and its tributaries and by the smaller streams which empty directly into the Susquehanna, as Mahantango, Sherman's, Middle, Penn's and Bald Eagle Creeks.

The streams in general have entrenched their courses from 50 to 400 or 500 feet below the level of the valleys which they drain, the larger streams being entrenched the most. Associated with the principal streams, also, are small strips of floodplain, or "bottom land," as it is locally called, representing the first step in the development of the lowland of the present cycle.

The main streams and their tributaries fall into two classes, acording to their origin: those flowing in inherited courses, and subsequent streams resulting from adjustment to structure since the uplift which terminated the Cretaceous cycle of denudation. The best instance of the inherited course is afforded by the Juniata, with its two main branches, the Raystown from the south and the Frankstown from the west. These streams, having gained their courses transverse to the structure on the surface of the Cretaceous paneplain, have been obliged to maintain the same courses during the subsequent changes of level. The result of developing their valleys in transverse courses is seen in the formation of no less than ten water gaps, where the streams have cut down through the hard ridge -making strata. These gaps, together with the smaller gaps made by the headward gnawing of some of the side branches, furnish the only easy routes to and from the different valleys.

Where they cross the ridges in the gorge-like water gaps the streams are swift, often descending short rapids, while across the intervening valleys they may flow lazily, in regularly meandering courses. The best examples of meanders are afforded by the Raystown Juniata in its course from Ray's Hill, in Bedford County, to its junction with the Frankstown branch, near Huntingdon. Along the lower part of the course, in particular, the meanders show the typical features of the incised type, the gently sloping, pear-shaped spur, the undercut steeper cliffs on the up-valley and the longer gentler slopes on the down-valley side, with here and there a narrow flood plain scroll at the base. A variation from the simple type is seen where the river flows along the base of the spur, on the inside of the bend, while a narrow strip of flood plain lies next the outer side. This characteristic of rivers has been called incompetence, and is well shown in the meander near the mouth of River's Run, in Liberty Township, Bedford County, with a second just below Fink Bridge, in the north-east corner of Penn Township, Huntingdon county. The nature of the change in stream action to cause incompetence at these places is not entirely clear.

Some of the smaller streams, notably Great Aughwick and Tuscarora Creeks, also show incised meanders, but in every case they are found where the streams flow along, instead of across, the belts of weaker rocks. This condition suggests that the meanders are not necessarily meanders which have been inherited and maintained since the original courses on the Cretaceous lowland, but were more probably developed on the valley lowlands previous to the latest uplift.

The second class of streams, the subsequents, flow along the belts of weaker rocks, in courses parallel to the structure, thereby making a sharp contrast with the transverse courses of the main stream to which they are tributary. The subsequent streams represent the drainage developed in the second cycle, during and after the uplift of the old peneplain: the streams, which, adjusted to structure, opened out the valley floors and left the ridges in relief. The chief characteristics of the subsequent streams are their long, relatively straight courses, parallel to the ridges and the valleys, with the short side branches flowing down the ridge slopes. No better illustration can be found than that afforded by Bald Eagle Creek, flowing for about 50 miles along the narrow floor of Bald Eagle Valley, and receiving on either side innumerable small branches from the slopes of the neighboring ridges.

Accompanying the development of the subsequent streams there was more or less readjustment of the lines of drainage. Small streams of the previous cycle, flowing across the outcrops of the hard ridge making strata, could not cut down so fast as the rapidly developing, stronger subsequents at work solely on the weaker belts. Hence many of the former were captured by the latter, their waters diverted, and the shallow notches which they had already cut in the ridges now make most of the so-called "wind gaps," often 300 or more feet deep, as Dry Gap in Fig. 2.

The combination of main streams transverse to the valleys, numerous subsequent tributaries in courses parallel to the valleys and receiving side branches from the bounding walls, has given an arrangement of drainage lines known as the "trellis" or the "grapevine" pattern. The trellis pattern is clearly shown in connection with the transverse courses of the Raystown Juniata, in Bedford County, and the main Juniata, from Lewistown to the Susquehanna. Perhaps the best example, on a smaller scale, however, is afforded by Great Aughwick Creek and its tributaries, in Huntingdon and Fulton Counties.

The adjustment of streams to folded structure, and the consequent development of the trellis pattern of drainage, readily accounts for the marked difference often noted as a peculiarity in the character of the drainage on the two sides of terraced mountains. Tussey Mountain furnishes a good illustration. On the side with no terrace the streams flow straight down the slopes in shallow channels, from crest to base. On the terraced side, however, the streams head up through the terrace in short deep gorges, above which they receive on either side a small branch from the shale belt, lying at a lower level, between the brow of the terrace and the main ridge.

Summary.

The Juniata region, a part of the folded mountain region of the younger Appalachians, shows evidences of at least three cycles. The first cycle reached the stage of a well developed peneplain, near the close of Cretaceous time, now shown only in the fairly even crests of the ridges. In the second cycle, instituted by broad elevation, re-dissection gave valley lowlands on the softer strata, while the harder strata, but slightly attacked, were left in relief as ridges. The third cycle, due to lesser uplift, has until the present time proceeded only as far as the entrenchment of the streams beneath the valley floors, with here and there narrow strips of flood plains beginning to appear. The previous conditions of folding, combined with the action of subsequent cycles of denudation and uplift, have given ridges and valleys of three structural types, monoclinal, anticlinal and synclinal; while among the ridges are found the parallel, converging and zigzag courses, with sloping anticilnal and sharp synclinal terminations. The streams of the region show the transverse courses of the main rivers, inherited from former cycles, with the resultant water gaps, and the subsequent streams in longitudinal adjusted courses, developed principally in the second cycle. All of the streams are entrenched in the still young present cycle; some of them in meandering courses; while the whole drainage system shows the trellis pattern characteristic of a folded mountain region of alternating hard and soft strata.

Phytogeographic Influences in the Arts and Industries of American Aborigines

JOHN W. HARSHBERGER, Ph.D.

Phytogeography, or plant geography in its widest sense, is concerned not only with the distribution of wild plants, but also with the laws governing the distribution of cultivated plants. In order to determine the origin of the latter, that is, the original center from which the cultivation of such plants has spread, it is necessary to examine the historic, archeologic, philologic, ethnologic and botanic evidence of the past use of such plants by the aboriginal tribes of America. This investigation affords interesting data which can be applied practically in enlarging the list of plants adaptable to the uses of civilized man. The study of plants with respect to their use by aboriginal races the writer has denominated ethnobotany.[1] Ethnobotany aids in elucidating the cultural position of tribes that used the plants for food, shelter and clothing. This phase of the subject concerns the present paper. Ethnobotany throws light upon the past distribution of plants and, as such, becomes a department of phytogeography. The ancient trade routes can be traced in many cases across continents by an ethnobotanic study. Ethnobotany is useful as suggesting new lines of modern manufacture, for example, new methods of weaving goods, as illustrated by the practical application of the careful studies of pueblo fabrics by Frank H. Cushing. It is of importance, therefore, to seek out these primitive races and ascertain the plants which they have found available in their economic life, in order that, perchance, the valuable properties they have utilized in their wild life may fill some vacant niche in our own, may prove of value in time of need, or when the population of America becomes so dense as to require the utilization of all of our natural resources.

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[1] Harshberger, J. W.: The Purposes of Ethnobotany, American Antiquarian, xvii, 73-81.

If we collate the facts which concern the present distribution of plants, we find that what appears to be in North America a flora of great heterogenity, resolves itself into a vegetation in which a few general types are distinctly recognizable. The coniferous forest reigned and reigns supreme over the entire northern part of the continent from the Atlantic to the Pacific and northward of the region of the Great Lakes. The deciduous type of forest in which oaks, elms, walnuts, maples, ashes, magnolias and other broad-leaved trees are supreme, covers the Piedmont plateau, the Appalachian Mountains, the Allegheny plateau and all the intervening country between this plateau and the Mississippi River, extending over the Ozark Mountains, and, by a southwestern tongue, reaching the northeastern portion of Texas. Up the streams and valleys of Nebraska and Kansas this forest in the past found its way. The Atlantic and Gulf coast plain was occupied, and is characterized still, by a coniferous forest in which the southern long-leaf pine, bald cypress and loblolly pine figure prominently. The great central plain of North America, stretching between the confines of the deciduous forest on the east and the Rocky Mountains on the west, and from the Saskatchewan River in the north to the Gulf coast in the south, was a treeless territory, in which grasses and other plants formed a close sod, excluding other vegetation. West of the prairies the sloped foothills and mountains are covered by a coniferous forest of an open type. Situated in the mountain valleys, surrounded by lodge-pole, piñon and yellow pines, are beautiful grassy plains that are called parks, dotted with trees. The Cascade and Pacific coast ranges are still covered by a forest of cone-bearing trees noted for the denseness of their stand, gigantic size and great age. Between the Rocky Mountain forest and the Pacific and Sierra forests is located the great arid, desert plains of the Great Basin, where the vegetation is of an arid type. South in Mexico, several phytogeographic regions occur. They are the tropic forest and chaparral vegetation of the hot lands (tierra caliente), the deserts, arid mesas and forested mountain slopes of the elevated Mexican tableland (tierra templada) and the mountain summits (tierra fria).

Having briefly delimited the principal phytogeographic regions of North America, it becomes important to connect the position of the various Indian tribes, or races, with the different types of vegetation. This will show the influence which the vegetation of the continent had upon the rise, development and character of the arts, customs and industries of the American aborigines. A preliminary statement will outline briefly the treatment of the subject matter of the following paper. The endeavor will be made to connect the various Indian families recognized by the Bureau of Ethnology with some definite phytogeographic area, and in the second place, to determine the influence of the plants of that area upon the peculiar character of the tribal culture, or stage of civilization. In order to facilitate treatment, the following order of procedure will be adopted. Plants used in the domestic arts, as implements for war, hunting, or fishing, and plants used for household employments, will be considered. General utility plants for lodge poles, sweat tepees, lumber, fencing, fibers and cordage, baskets, mats, clothing and bedding, soap, hair-washes, oils, paints, dyes, stains and branding, follow in natural sequence. Plants used as food, in the form of roots, bulbs, tubers, herbage, bark, fruits and seeds, meal and flour, sugar and syrup, etc., will be mentioned. Plants used in smoking and forage and for medicine complete the list.[2]

Eastern and Northern Forest Region.

According to the map issued by the Bureau of American

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[2] Blankenship, J. W.: Native Ecenomic Plants of Montana, Bull. 56, Mont. Agri. Exp. Station, April, 1905.

Ethnology, in its Seventh Annual Report, illustrating the position of the linguistic stocks of America, the northern coniferous forest, as far west as the Canadian prairies, as well as the deciduous forest of the east, was occupied by two great Indian stocks: the Algonquian and the Iroquoian (Map A and Ir.).

We find that the industries and arts of these tribes was influenced directly by the dense forests in which they lived. Their food was largely the forest animals trapped or slain in the chase, and fishes caught in the lakes and rivers of the region. This animal diet was modified by the use of wild berries, such as huckleberries, blueberries, service berries, wild grapes and wild cherries. Cultivation of the soil was merely an incident among some of these forest tribes to help eke out a usually abundant food supply. Corn was planted in open places in the wood, while beans and pumpkins also were grown.

The French arrived in Canada in 1534. Cartier sailed up the St. Lawrence River, and in 1535 reached the present site of Montreal, where he saw the Indians planting their bleds d'Inde. In every hill they put four Brazilian beans, which, as they grow, wind about the corn to the height of five or six feet. The Puritans found corn cultivated in New England, and in 1621, after the first hard winter was over, Squanto showed them both "ye manner how to set it," and after how to dress and tend it. Quaint old Gabriel Thomas, writing about 1696, tells us that "they live chiefly on maze or Indian corn, roasted in the ashes, sometimes beaten, boyled with water."[3]

The dense forests prohibited rapid transit of large bodies of men from one part of the country to another. Advantage was taken of the rivers, lakes and salt lagoons of the Atlantic drainage system. The need of a light vessel which could be carried easily across stretches of the forest led to the evolution of the birch bark canoe. It may be said to be the peculiar vehicle of navigation of the Algonquian and Iroquoian tribes which occupied the country coincident with the phytogeographic distribution of the paper birch tree (Map: C, B and A, A, Ir., Ir.). The distribution extended from a line connecting Newfoundland and Alaska south as far as a line curving through central Pennsylvania along the southern ends of Lakes Erie and Michigan, northwest to the Canadian Rocky Mountains. The southern line is almost coincident with the southern limit of the great continental glacier. This is the territory covered by the early explorations of the French voyageurs, who took advantage of the light birch canoes of the Indian to penetrate along the St. Lawrence, Great Lakes and smaller lakes far into the interior of the continent. The history of the birch bark canoe is to be written some day, and it must be conceded that it played a very important part in the settlement of the American continent.

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[3] Harshberger, J. W.: Maize: A Botanic and Economic Study, Cont. Bot. Lab., U. of P., I No. 2, p 182, 1893.

How the Indian canoe was evolved is an interesting problem. The forest tribes soon learned that the tough, resinous, durable bark of this tree could be separated easily into thin layers. Impervious to water, the light birch bark was indispensable to the northern tribes of Indians. They knew that sheets of this bark twelve feet long and six feet wide could be peeled from a canoe birch tree two feet in diameter, and they also knew the season at which the outer layers could be removed most easily. The method of caulking the canoes, when constructed, depended for its success upon the use of other forest products, such as balsam resin or vegetable gums. Birch bark was used also in the manufacture of carrying baskets, drinking cups and many articles of domestic use.

All along the border, and in many parts of Canada, the Algonquian and Iroquian tribes make baskets from the birch, linden and other white woods indigenous to the region. The method of manufacture[4] is the plainest in-and-out weaving, and yet the basketry shows the greatest variety of form, color and ornamentation. The colors are of native manufacture, red, blue, yellow and green, alternating with the natural colors of the wood. By changing the relative sizes of the splints and hoops, a great variety of baskets is the result. The soft wood of the white birch is still employed by those northeastern tribes in the manufacture of baskets. The wood of a hickory, perhaps Hicoria ovata, was used by the Six Nations in New York and in Pennsylvania. Holy grass (Hierochloe (Savastana) odorata) was, and is still, used by the Penobscot Indians in the manufacture of sweet-scented baskets.

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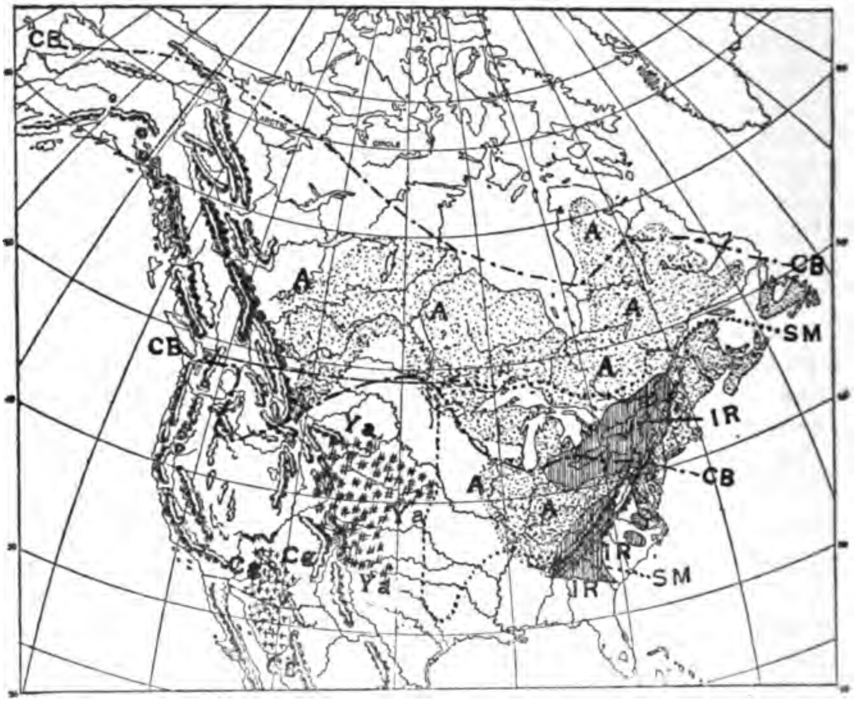
[4] Mason, Otis T.: Basket Work of the North American Aborigines. Rep. Smithsonian Inst., 1902, Pt. II.



CB—Geographic limits of canoe birch (Betula papyrifera).
SM—Limits of sugar maple (Ascer saccharum).
A—Seat of the Algonquin tribes.
IR—Seat of the Iroquoian tribes.
Ya—Habitat of soapweed (Yucca angusifola).
—Habitat of Suwarro (Cereus giganteus).

Sugar-making was another industry almost peculiar to the Algonquian and Iroquian tribes of American Indians. Bossu, a French officer, who travelled in America between 1756 and 1771, states explicitly that the French learned the method of sugar-making from the Indians.[5] By some of the northern tribes the sweet sap of the canoe birch, which flows freely in the spring from wounds in the trunk, was made into syrup. The tree, however, used almost universally in this phytogeographic territory was the sugar maple (Acer saccharum). This tree is found in rich woods from Newfoundland to Manitoba, especially along the mountains to Florida, Nebraska and Texas (Map S. M.). The forest Indians had learned before the advent of the white races that the maple sap will not flow from the trees unless the conditions of the weather are favorable. The time during which the sap flows varies from February to May, according to latitude; and the length of time it remains flowing differs greatly, even in the same grove, in different years. The first flow of sap comes with the first days which are warm enough to cause the snow "to give," as the farmer says. After that the most favorable weather is a succession of cold frosty nights followed by warm, sunny days. Occasionally the sap will flow all night, if it is warm, but generally the flow stops at night, to begin anew the next morning. As the snow melts and the ground warms up under the spring sun, the flow decreases, until, with the swelling of the first buds, it ceases entirely. The Indians apparently knew these general facts and the method of sugar extraction. The latter tested their ingenuity, and is in some measure an index of their mental development and culture. Work began in March. Mounted on his stout snowshoes, the aboriginal sugar-maker started out to tap the trees. By means of a tomahawk he cleaned the rough bark from a spot on the side of the tree, making an incision an inch deep. A spout of bark was perhaps used, and the sap conducted into some receptacle provided for the purpose. It was afterward boiled and cooled, giving the maple syrup and sugar regarded as great delicacies by the Indians.

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[5] Sargent, C. S.: Silva of North America, 11: 99.

Of the drinks of the eastern tribes of forest Indians not much can be said, for the reason that, generally speaking, they had nothing but water, and, curiously enough, they preferred it warm and stagnant. Occasionally they made milk of hickory nuts, and they diluted and drank broth in which their hominy was boiled. The sap of the sugar maple, according to La Hontan, was also drunk, and elsewhere they flavored their drinking water with "ginger, saxifras and other wholesome herbs."

The Iroquois Indians, inhabiting the country about Lakes Ontario and Huron, subsisted for a part of the year on the nutritious seeds of the wild rice (Zizania aquatica), which grew in the marshy places along the lake and river. The fruits of this important grass, rich in nitrogenous, or muscle-forming substances, was gathered into conical baskets, a wicker-work paddle, or flail, being used to knock the achenial fruits from the plants. The fields of wild rice were reached by canoe, by which means the Indian gleaner often secured a large store for winter use.

Great Plains—Rocky Mountain Region.

A selected list of plants used by the Indians of Montana illustrates the principle that primitive man closely adapted himself to his environment, and that the degree of his culture was largely dependent upon the extent to which he laid the natural resources of his environment under contribution. The plants used there were from the forest formations of the mountains and from the adjacent great plains. For example, in the making of arrow shafts the following plants were used: Rocky Mountain service-berry, reed, plum and snowberry. Their bows were usually made of the branches of the green ash or of the yew.

Their canoes were constructed of birch bark and the hollowed out trunks of such trees as yellow pine and white cedar. The trunks were hollowed by fire to form the native dugouts, and the inner bark of the yellow pine was employed for food in the spring. "When the American Indians intended to fell a thick strong tree," says Kalm, "they set fire to a quantity of wood at the roots of the tree. But that the fire might not reach higher than they would have it, they fastened some rags to a pole, dipped them into water, and kept continually washing the tree a little above the fire." "Whenever they intended to hollow out a thick tree for a canoe they laid dry branches all along the stem of the tree as far as it must be hollowed out. Then they put fire to those branches, and as soon as they were burnt they were replaced by others. Whilst these branches were burning the Indians were very busy with wet rags and pouring water upon the tree to prevent the fire from spreading too far."[6] The interior of the hollow tree trunk was then dressed by copper or stone implements. The bark of the white cedar of the northwestern forests was used by the Indians to make canoes and the framework of willow baskets; the inner bast was made into sacks, into cord for fish nets and woven into cloth; the wood was employed as floats for nets.

The smaller trees of lodge pole pine, as the name implies, were deprived of their bark and the straight pole-like stems were used in the construction of their wigwams, tepees or lodges. A considerable traffic was carried on, for the Indians of the plains were compelled to travel hundreds of miles to the Rocky Mountains, where they obtained the slender, straight and light stems of this tree, practically the only one of this region suitable for forming the framework of their tepees. The roots of the soap weed, or grass cactus (Yucca angustifolia), were extensively used as a substitute for soap by the various tribes occupying the eastern plains (Map Ga.), where it is native.[7] It was particularly valuable as a hair wash, producing a lustre not otherwise obtainable.

The foods used by the Montana Indians, in addition to those obtained from the animals, were procured from a variety of plants found only in the Rocky Mountain region. The ingenuity which the Indians displayed in the preparation of these foods was great, and the list of plants whose properties and uses they knew was extensive. The biscuit root (Camassia esculenta) was one of these plants. The plant grows in the low open meadows in the mountain valleys, often in great abundance, and here the Indians congregated in the "camass season." The bulbs, according to Blankinship, were dug about the time when the flowers on the lower half of the cluster began to fade. The bulbs were then baked in the ground by hot stones and dried for winter use.

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[6] Quoted in Mason, Otis T.: The Origins of Inventions, 1895, p. 212.
[7] Blankinship, J. W.: *Loc. cit.*, p. 27.

The smoking habit was one of the characteristics of the American Indian, especially among the tribes which occupied the present State of Montana. Wild tobacco was once cultivated extensively for smoking, being mixed with four times its bulk of "larb" (Arctostaphylos) or of "Kinnikinnick" (Cornus stolonifera). The most delicate tobacco was prepared from the flowers.

Pacific Coast Forest Indians.

The Klamath tribe in Oregon learned to use at least eighty-eight native plants. This seems a small number, but how few American plants relatively have white men learned to use independently of the Indians. Reference can be made to only one or two of these plants by way of illustrating the influence of the distribution of plants on the tribal customs and industries. The trees of Oregon and California are draped with a light, yellowish-green lichen (Evernia vulpina) confined to that region. The Klamath Indians learned that a yellow dye could be extracted from this so-called yellow moss. Porcupine quills obtained from the Modocs by barter, immersed in a decoction of this lichen, take on a beautiful, permanent bright yellow hue. These quills are woven into baskets to give different yellow patterns.

The great yellow spatterdock grows in the marshes of the Klamath region. The large, mucilaginous seed pods, according to Coville,[8] are gathered in boats, the seeds extracted after some process of drying the pods and then stored for use during the year. The common method of preparing the seeds for use is to roast them in an open basket with live coals. The roasted seeds are eaten dry, and form, perhaps, the most important farinaceous food of the Klamaths.

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[8] Coville, F. V.: Notes on the Plants Used by the Klamath Indians of Oregon. Cont. U. S. Nat. Herb. V., p. 96, 1897.

The Yosemite Indians, in the Yosemite Valley, depended for their winter supply of food upon the acorns from the oak trees of the region and the seeds of the piñon pine, for which they made long journeys across the mountains. The acorns of the valley oak were considered the most nutritious and appetizing, containing only small quantities of the astringents found in the acorns of other species of oak. These acorns were gathered in conical baskets carried on the back and supported by a head band across the forehead. The acorns were stored in caches consisting of a hollow central log with a hole at the bottom, large enough to accommodate the hand. This outlet pipe was surmounted by the granary roofed with pine boughs interlaced with bark and grasses into a conical form above. As the acorns were removed from the hole below a fresh supply rattled down. The acorns were ground for use on a flat rock by means of a rolling pin, or rounded hammer, of stone.

Arid Plains—Desert Region.

Perhaps the most curious relationship of primitive man to his vegetable environment is found in the southwest, where a species of cactus (Anhalonium Lewinii)—a half inch high —grows in considerable abundance. It is found in the valley of the Rio Grande, in Mexico, growing in barren and even rocky soil, and often in places which can be reached only with difficulty by those who gather it. The body of the plant is comparatively thick and is surmounted by the closely set, succulent and blunt leaf cushions (mammillæ). In the center of this top is a tuft of yellowish-white filaments, or hairs. These tops, when dried, constitute the mescal buttons. The button is somewhat brittle and hard, but in the mouth, however, under the action of the saliva, it swells and rapidly becomes soft, the consistency which it acquires giving the sensation imparted by slippery elm bark. The taste is decidedly disagreeable, nauseous and very bitter, with a persistent after-taste. A marked sensation of stinging, or tingling is produced in the fauces, which remains for a considerable time after the drug has been swallowed.

The Kiowa Indians for generations occupied the valley of the Rio Grande, and some of the members of this tribe became addicted to the use of the mescal buttons, which they used in their religious ceremonies. These ceremonies at the present usually take place on Saturday night. The male Indians, having obtained their supply of mescal buttons, seat themselves in a circle around a large camp-fire, which is kept burning brightly. A button after having been freed from the tuft of hairs is put into the mouth, and, after it is thoroughly softened, it is ejected into the palm of the hand, rolled into a ball, and then swallowed. In this way ten or twelve of the buttons, as a rule, are taken at intervals between sundown and 3 a. m. Throughout the ceremony there is no dancing or singing, but the camp-fire is kept burning brightly and a continual beating upon drums is kept up by the attendants. The Indians sit quietly in a state of reverie, the intoxication of the drug showing itself in the visions of color and other manifestations. The visions, according to experiments carried out with the drug isolated from the plant,[9] range from ill-defined flashes of color to most beautiful figures, forms, landscapes, dances—in fact, there seems to be absolutely no limit to the variety of hallucinations which the drug can produce. Drumming, or otherwise marking regular time, enhances the beauty and variety of the objects seen. As the effect wears off the Indians get up and go about their work, it is claimed, without the slightest depression or unpleasant after-effect.

Several other plants illustrate the dependence of the Indians on the desert plants of the Southwest and show the adaptation of means to ends. Each plant is used in some particular way, and the use of the different plant parts is almost always sure to show some new method of aboriginal industry, or some new method of husbanding the natural resources of the country.

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[9] Morgan, F. P.: Anhalonium Lewinii (Mescal buttons). A study of the Drug, Therapeutic Gazette, XIX, pp. 577-585, September 16, 1895.

The giant cactus, Arizona candle or Suwarro, is abundant on low rocky hills and dry mesas of the deserts of New Mexico, through central and southern Arizona to the valley of San Pedro River, and southward into Sonora (Map Cg.). It grows to a height of fifty feet, with a tall, cylindric, usually unbranched and fleshy stem, with deep flutings or ribs, studded with clusters of heavy spires that burn readily. Alternating with the ribs are ligneous fascicles, supporting the soft tissues which constitute the bulk of the plant. These woody bundles, or skeleton of the plant, afford excellent firewood, and are used to make cattle corrals. The plant blossoms early in May and the fruits are ripe in August. These fruits are gathered by the Indian women by means of pointed poles, and are preserved as food, or used to make a beverage of which they are very fond.

The bisanga, or "well of the desert," as it has been appropriately called, is a cylindric cactus covered with sharp spines. The desert Indians have discovered that by cutting out the center of the plant a bowl is formed, which quickly fills with water of an excellent quality, affording a refreshing drink.

A desert pigweed, Chenopodium cornutum, is utilized by the Hopi pueblos in an interesting manner. In their language it is called *Kotoki,* signifying the popcorn plant, so named because, they say, it flings its ripe seeds abroad like decrepitating corn flying from a vessel held over a hot fire. Its seeds are ground and mixed with cornmeal to make *somipiki,* small dumplings wrapped in corn husks and tied with a string of yucca.

A native grass (Muhlenbergia pungens) is called by the Hopi *Wügsi* (from *wügti,* woman; *sihü* flower, a satiric name), because the women use it as a brush. The same bunch of grass serves a double purpose, for, with the stiff end, they brush the hair, and with the more flexible tip end they sweep the floor.[10]

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[10] **Fewkes, J. W.: A Contribution to Ethnobotany, American Anthropologist, January, 1896, p. 16.**

Of all the plants cultivated or wild that were utilized by the desert tribes of Indians, corn, or maize, was of most importance, for it was used as food, fuel, dress, ornament, and in nearly all of their religious ceremonies in some form or other. Its importance as a plant to the aboriginal husbandman was fully recognized, and the stage of cultural development of the pueblos was largely the result of the cultivation and dependence upon this one plant. Through the researches of Frank H. Cushing, whose studies of the economics of Zuni corn were published twenty years ago in the Indianapolis Millstone, we have given an interesting account of the planting, cultivation and harvesting of Indian corn, part of which account is condensed here. A study of these methods throws an interesting light upon the mental development of the Zunis and related pueblo tribes.

The Zunis plant their selected corn with important ceremonies. At planting time plumed prayer sticks are selected from a fawn-skin pouch, each kernel of a different color, and these kernels are wrapped in a broad husk with the plumed wand. Slinging the pouch over his shoulder, the Zuni farmer takes up the old planting stick and steps out of the doorway, meanwhile being sprinkled with fresh cold water. Arrived at the field, the planter goes to a well-known spot near the center, where he digs four deep holes equidistant from the central point in the cardinal directions, east, south, west and north. By the left side of the north hole he digs another hole to represent the sky regions, and by the right side of the southern hole still another relating it to the lower regions. In the central space he kneels, facing the east, and, drawing forth the plumed prayer wand, first makes a cross on the ground by sprinkling prayer meal. Then, with prayer, he plants the plumed stick at the intersection of the cross, sprinkling it also with prayer meal. From his pouch he selects three grains of each of the six colors and places them respectively with the six grains of like colors which had been wrapped in the husks. The Zuni planter now, kneeling, holds the four grains of yellow corn in his left hand, and, facing the northern hole, hums the first verse of a planting chant.

"Off over yonder
Toward the North land,

Will it but prove that my yellow corn grains
Shall grow and bear fruit, asking which I now sing."

As he sings the refrain he drops the yellow corn into the hole toward the north, covering the grains with earth, while in rows corresponding with the direction of the four hills he plants the kernels of corn far out into the field until all of the corn in the fawn-skin pouch is exhausted. Then he returns home, fasts and abstains from all pleasures until four days have passed, when he may again plant corn.

The same elaborate ceremonies are followed when the corn is harvested and stored in the native granaries, which usually are guarded carefully. What has been said about the ues of this important cereal has abundantly proved that the industries of the American aborigines and their religious observances were conditioned largely by the distribution of the native plants which furnished them with food, clothing, medicine and building materials.

Mexican Plateau Region (Tierra templada).

The maguey, or century plant, is native to the highlands of Central Mexico, ranging from 6000 to 7000 feet altitude. At present the plants are grown on large plantations, or haciendas, thousands of acres being devoted to its cultivation. From it the Mexican Indian obtains the native beverage, ***pulque,*** and a fiber that, as Mexican fiber, is used for making rope, cordage, bagging, matting, thread, clothing, hammocks and other coarse textile stuffs. The earliest use of pulque is said to date back to the latter half of the eleventh century, long before the conquest, and to the reign of the Indian chief Tepzucoltzin.

The tlachiquero, or sap gatherer, is duly protected from the sharp spines of the plant by a leather apron, heavy sandals and a leather knee protector. His tools consist of a metal scraper and a long hollow Mexican gourd, or calabash, with small holes at both ends. The Indian husbandman carries on his back a large pigskin pouch, which he fills with maguey sap on his rounds from plant to plant. Cautiously working his way in between the leaves, the tlachiquero cuts the rapidly elongating flower stalk out of the center of the plant and with his scraper digs out the heart of the stem a few inches deep. This depression he covers with a piece of maguey leaf weighted down with a stone. Each plant is treated in exactly the same way. Visiting the field the next morning, the tlachiquero finds an abundance of sap, called *aguamiel* (literally honey water), in each depression. This aguamiel is removed by means of the gourd, over the large end of which the lips are placed and suction applied. Very quickly all of the liquid is drawn into the gourd and then transferred to the pigskin pouch on the back. One load after another of this aguamiel is packed on the man's back to the building where the pulque is made. There the sap is poured into vats made of cowhide, arranged in long rows in well-ventilated galleries. A small quantity of fermented sap is poured into the fresh liquid, in order to start the process of fermentation. When the fermentation is accomplished, the aguamiel has been transformed from a sweet into a sour beverage, with a combination of flavors resembling buttermilk, liquid yeast and ginger beer, and with a whitish, or grayish, froth on the surface when freshly poured. The pulque often undergoes a watering process at the hands of the carriers, who convey it in the skin bags upon the backs of burros, or in hogsheads placed in a cart drawn by donkeys hitched tandem.

Of late, however, regular pulque trains are run from the maguey fields to the large cities. The quantity of pulque which annually enters the City of Mexico alone is estimated at 9,125,000 gallons; Puebla received about 3,000,000 gallons, and the cost of transportation is estimated at $1,250,000. In the large cities where pulque is sold at the various pulque shops the outer walls are often decorated with elaborate mottoes and mural designs, and such names of identification as El Diluvio, La Sonora, Un Viaje al Japon are not uncommon. When served for the table among the better classes, the taste and odor are somewhat disguised by the addition of the juice of the prickly pear, pineapple, orange or other fruits. The preparation is then called *pulque compuesto,* and is a fine beverage. The medical virtues of this drink are many and valuable, acting beneficially upon the digestion, blood, nerves and the entire system in general. It is a powerful tonic and perhaps has laxative properties as well. But its immoderate use by the poorer Indians is bad, and is now discouraged by the Mexican Government.

These typical examples will serve to indicate that the primitive American races were influenced in the character of their arts and industries by the native wild plants of the region where they lived. The completeness with which the aboriginal craftsman utilized the products of his particular habitat demonstrates the long or short occupancy of a certain geographic district. Where many plants were utilized, presumably it indicates that a certain tribe had been associated for a long time with that particular land area. Where only a few plants were used, the tribe using such plants had been residents only a short time.

An exhaustive treatment of this subject would fill to overflowing the pages of a large volume, and would lend itself to illustration by maps, half-tones and colored plates. Enough has been presented, however, to demonstrate that the distribution of plants, and their growth in definite geographic areas has had a distinct influence on the arts and industries of the primitive tribes.

University of Pennsylvania.

IN THE HIGH SIERRA.

In æons past, where mighty glaciers stood
As silent sculptors of the future vale
And foothill gardens and the smiling dale,
Now stands a mountain range with fir-fringed wood,
And from uplifted heights this dark green hood
Erstwhile slips back, disclosing snow, pure, pale
And still, and dream-like seems the whistling gale
Which swept adown the slope for healthful good.

In solemn grandeur rises peak on peak,
The snowy range is cleft with dazzling light
As flashes forth a glist'ning fall, sun-flushed.
Go, ye who peace from ravening care would seek,
And find it 'mid the trees, as deepening night
Bids day depart and all the world is hushed.

Laura Bell.

Photograph by Henry G. Bryant.

"—a mountain range with fir-fringed wood."

ACTIVITIES OF THE SOCIETY

Geographical Excursions in the Neigborhood of Philadelphia: Journey II.

A Trip to Bonaparte Park at Bordentown

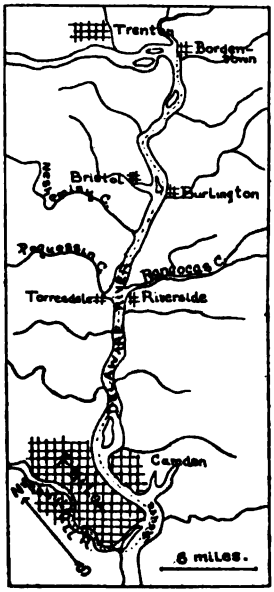
"An excursion of the Geographical Society will be made on June 13th to points of interest up the Delaware River.

"The members of the party will meet at the entrance of the Baltimore and Ohio Railroad Station at Twenty-fourth and Chestnut Streets at 9 a. m. The boat *will leave* at 9.15."

Responsive to this summons, a pleasant party, comprising a large number of the members of the Society and their friends, met at the steamer at the appointed time.

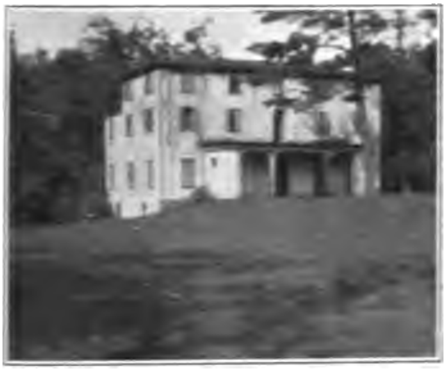
A trip down the Schuylkill is not a common one. The river, broadening over its more level course and with many a curve, widens to its union with the Delaware. Along its banks many points of interest claimed attention. Woodlands, with the beautiful colonial home of the Hamiltons, south of the University Grounds, on the west bank, farther down Gray's Ferry drawbridge, Bartram's Gardens, whose charms demanded a special visit at a later date, the great tanks and foreign vessels at the Point Breeze oil works—these and other interests demanded constant observation.

Rounding League Island with many ships at the Navy Yard in view, the course turned to the northward, and the busy river front of the city was passed. Old Swedes' Church, now Gloria Dei, showed its roof and steeple at Swanson Street. The factories, steamship docks, both domestic and foreign, and ferry slips followed in succession until the boat reached Cramps' Ship Yard, near Pettys' or Treaty Island, where the first halt of the journey was made. It was a busy scene at the ship yard. Probably the most interesting feature of the visit was the exploration of the depths of a large man-of-war then in process of building, through which most devious ways were taken. As the ladders up the sides of the vessel were being mounted the noon hour whistle blew, and the most remarkable appearance of hundreds of workmen from every nook and corner in the ship rushing for the ladders was a startling surprise. They seemed to swarm as by thousands. Probably nowhere in the city, or possibly in the country, is a more powerful impression of human force and accomplishment to be found. It seemed a magnificently busy world—building the splendid ships to gird the seas. The party was most courteously received and escorted during the visit.

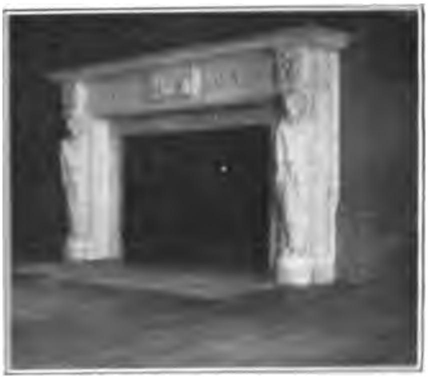


Leaving Cramps' Ship Yard, the journey continued northward, under the Pennsylvania Railroad bridge, past the busy towns and villages, in view of many beautiful country homes along the shores. The banks on both sides gain in beauty as the river narrows and the shores grow steeper. Bordentown, the goal of the journey, was reached toward the middle of the afternoon. On the high cliff south of the town the home of Commodore Stewart, "Old Ironsides," was pointed out.

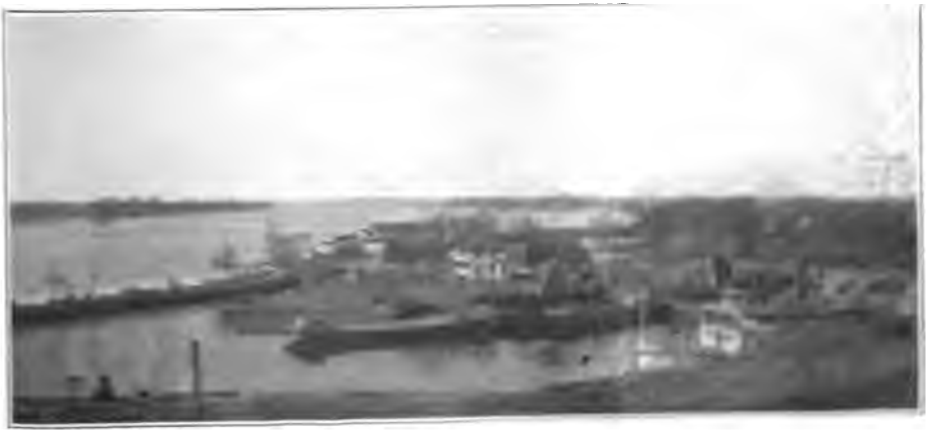
The boat was moored at the foot of the steep decline, whose grassy and cobbled road between two high stone walls makes the most charming approach to this quaint and beautiful old Jersey town. Climbing this roadway led to the old house, once the home of Thomas Paine. Turning to the left along the cliff a splendid view northwestward to Trenton commanded the Delaware, the beginning of the Delaware and Raritan Canal and Crosswicks Creek. From this point an attractive walk was taken to the Bonaparte Park, on the wooded hill known as Point Breeze, and once including more than a thousand acres—one of the most charming places in the neighborhood of Philadelphia. The park, once owned by



"Lake House," home of Prince Charles Lucien Bonaparte, at Bonaparte Park, Bordentown.
—*Photograph by Miss Mary W. Bonsall*



Marble mantelpiece, given by Cardinal Fesch to Joseph Bonaparte.
Photograph by Miss Mary W. Bonsall



View from bluff at Bordentown—the Delaware River, Raritan Canal and Crosswicks Creek, with Trenton in the distance.
Photograph by Miss [illegible]

Joseph Bonaparte, known here as Count de Survilliers, ex-King of Naples and of Spain, is now owned by St. Vincent's Seminary, and it was owing to the courtesy of the officials that the party was given the freedom of the grounds and house. Had the date been later than June 15, no woman could have entered, as the students are there for the summer and women are debarred.

Through the kindness of Mr. William MacFarland, of Bordentown, who acted as guide, the story of the Bonapartes was rehearsed. The party sat upon the ground under the splendid trees of the "Lake House," at the left of the entrance to the grounds. This house was the home of Prince Charles Lucien Bonaparte and his wife Zenadia (his cousin), daughter of Joseph. Charles Lucien Bonaparte is best known in America for his work in ornithology, working here in the park and neighborhood. His first publication, "American Ornithology," was independent, but later he published with Alexander Wilson on the same subject. From the "Lake House" one of the underground passageways leads to the side of a bluff which overhangs a ravine through which a small stream runs, and the flight of brownstone steps still descends to near the ruined exit of the subterranean path. Opposite the "Lake House" the servants' quarters still stand amid the splendid old pines. Wandering through the beautiful grounds, the old "belvedere" foundations, the secret passages, the jungles of rhododendrons on the slope of cliffs that overlook Crosswicks Creek—all had their charm. In the house now standing, built by Mr. Beckett after the death of Joseph Bonaparte in 1844, only the two beautiful marble mantelpiecs from Italy, a present from Cardinal Fersch to his nephew, remain of the original treasures.

The story of this dethroned king, who, having won two crowns, refused, it is said, a third proffered by Mexico, is a fascinating one. He was much beloved by the people of the countryside, to whom his mansion was "The Palace" and his title "King," and when to-day some jest is made of one sister state as "Spain" we trace it to the romantic history of this exiled monarch, who made the Bonaparte Park a place of magnificence and a beauty, a part of whose charm remains to-day.

Leaving the park, a walk to the boat passed the substantial stone house of Francis Hopkinson, a signer of the Declaration of Independence —continued along Farnsworth Avenue, the main street, which led to Farnsworth's Landing. The name commemorates the first settler who came from England to Burlington in 1681. Reaching the landing, the party embarked for the homeward sail down the river—a beautiful trip, which ended at sunset. At Arch Street wharf the party disbanded, each going his way with the memory of another day's experience, teaching once more the lesson of the interests and beauties of our own neighborhood.

MARY S. HOLMES.
Chairman of the Excursion Committee.

Book Reviews

Census of the Philippine Islands: 1903. Four volumes. United States Bureau of the Census. Washington, 1905.

Volume I contains five chapters, giving much interesting information concerning the geography of the islands, comprised under the titles: Physical Formations, Climate, Volcanoes and Seismic Centers, Elevations, and a list of the islands.

The islands so far listed number 3,141, but of these, so far as known, 1,473 are without names. Their total area is given as 115,026 square miles, over two-thirds of which is in Luzón and Mindanao alone. Seven-eighths of all the islands, 2,775 in number, have areas of less than one square mile each.

The combination of location and physical features of the archipelago in itself give it the form of a triangle open at the base and with its apex to the north, represented by northern Luzón. The legs of the triangle are made by two partially submerged isthmuses connecting the archipelago, through Mindoro and Paragua, with the northern end of Borneo; and, through Samar, Leyte, Mindanao and the Sanguil Archipelago, with the northeast point of Célebes. A third axis through the Zamboanga Peninsula and the Sulu Archipelago connects with the northeast of Borneo, Between these axes lie the nearly enclosed basins of Sulu and Célebes Seas. The connections with the Pacific and China Sea are everywhere shallow, as a result of which the enclosed waters are, as a rule, much warmer than those of the adjacent oceans, since only warm surface water can flow through the shallow passages.

The three lines of elevation converge northward in central Luzón, and combining there, appear to form the mountain system in the northern part of the island. Northern Luzón is described as more mountainous than most of the other areas, but all the islands of any importance have a backbone made by a mountain range, the general trend of which is north and south. Paragua offers an extreme example, being 275 miles long with an average breadth of 15 miles, most of which is taken up by a range of mountains between 4,000 and 5,000 feet high.

The volcanic origin of the archipelago and the attendant oscillations of the land have combined with the growth of coral reefs to give the islands a very intricate coastline. Thus with the area of only 115,000 square miles, the coastline is more than double that of the main body of the United States. With such an extent of coast there are many harbors of one sort or another. Most of them are of sufficient depth to admit large vessels, but are often difficult and dangerous of entrance, due to the reefs which obstruct them. It is also interesting to note that a harbor good at one season may not be good at another, owing to the seasonal change of the winds which prevail throughout most of the archipelago. The United States Coast and Geodetic Survey has classified the principal harbors according to the size of vessel they will accommodate and the season when they are safe.

The entire archipelago is described as mountainous or hilly; and though there are broad plains and level valleys in the larger islands, there is comparatively little level land—in many cases limited to a mere strip along the coast. The ruggedness of the ranges is, however, said to be softened by the tropical vegetation which grows high up on the slopes, and gives a type of scenery which is beautiful but rarely grand.

The most pronounced lowland lies back of the Zambales range on the island of Luzón. It is described as a great valley, 150 miles long, with an average width of about 50 miles. The surface is very level, rising more than 100 feet above the sea only near the bounding ranges, and is traversed by many streams. Much of the land is made of alluvial deposits, and in the neighborhood of Manila Bay and Lingayen Gulf is marshy for many miles. Manila Bay, with a maximum depth of 25 fathoms, is evidently a part of the same depression. From the description it appears that the plain is largely the result of rapid delta building by the numerous rivers in original broad areas of the sea, of which Manila Bay and Lingayen Gulf are the still unfilled portions. The plain is of added interest from the fact that although it comprises less than one-fifth the area of the island it supports more than two-fifths of the population.

The rivers in general are short, flowing down the slopes of the ranges near the coast. Most of them are not navigable except near the mouth. Notable exceptions, however, are found in the streams flowing on the level areas of Luzón and Mindanao, and the largest stream in the islands, Cagayan River, in eastern and northern Luzón. It is navigable for small boats for 200 miles from the mouth, and acts as the main highway for the products of the provinces which it traverses.

More interest, perhaps, is afforded by the volcanic features than by the other more common forms. There are known to be twelve volcanoes in the islands which have been active in historic times, while there are scores which are quiescent or extinct. The volcanoes present all stages of form and size—from the great crater lake, known as Lake Bombon, 12 miles in diameter, to the perfectly symmetrical cone of Mt. Mayón, rising from the sea to a height of 7,916 feet. Associated with the large numbers of volcanoes are the usual frequent earthquakes. The report contains an interesting discussion of the various seismic centers, with a chart of the islands showing the relative frequency of earthquakes. From observations for eighteen years, 1880-1897, for the whole archipelago, there was found to be an annual average of 53.4 earthquake days—*i. e.*, omitting the after-shocks, which often continue for many consecutive days from the same center.

The discussion as a whole is necessarily incomplete, since much of the region has yet to be charted accurately; but there is still much of interest to the general reader, well told and supplemented by numerous illustrations and several maps.

WALTER S. TOWER.

CLIFFORD, HUGH, C. M. G. *Further India.* Pp. 346. Appendix, 2 Maps. Frederick A. Stokes Company, New York. 1904.

One of the interesting "Conquest of the Globe" series edited by Dr. Scott Keltie. The title page tells the scope of the book—"the story of exploration from the earliest times in Burma, Malaya, Siam and Indo-China."

The opening chapters deal with the early ideas held by European peoples concerning the mysterious regions of the Far East. They are accompanied by several reproductions of curious old maps portraying these ideas. The accounts of the mediæval wanderers follow, in which, of course, the ever new exploits of Marco Polo play the leading part. Then come the early Portuguese traders, including extracts from the voyages of Vasco da Gama, de Siqueira, and the great Dalboquerque (Albuquerque) the founder of Portuguese power in the East.

The story of the Portuguese is especially interesting, for though they exploited only the coasts and the places easily accessible from the sea and their undisputed tenure was short, they left indellible traces of their presence. In the words of the author: "The traces of the Portuguese traders have not even now completely vanished, and in almost every town of any size in southeastern Asia men are to be found bearing historic names of Portugal, speaking a bastard dialect of the peninsula, and . . . cherishing a passionate disdain for the full-blooded Oriental." The East India companies, English and Dutch, supplanting the Portuguese, opened up to white men much more of the East during the seventeenth and eighteenth centuries. The pages devoted to them show how the way was paved for the exploration of the interior.

The work of the French expedition in 1866-1868, under Legrée and Garnier, the account centering about the person of Francis Garnier, makes by far the most attractive part of the book. The figure of the man himself, the chronicles of his adventures, and the vivid portrayals of the wonders of the country may well make the reader wish for a more complete story. It is well worth while to read all the other chapters for the sake of the glimpses at the character of the lost Khmer civilization, a civilization thriving at the opening of our era, able to build walled cities, great temples, with wonderful carvings in stone, and stone bridges with a central span 148 meters long, 15 meters broad, and 30 meters above the river.

No less attractive are the wonders of nature, as in the description of falls in the flooded Mekong River. "In the two principal falls the stream runs in absolute cascades, the body of the water being more than

1,000 yards across, and plunging vertically from a height of fifty feet. From bank to bank the broken line of falls, rushing through the group of islets, measures between seven and eight miles in width, while immediately above the river is twelve miles across."

The last few chapters are devoted to a much less interesting account of later explorations and advancement of the geographical knowledge of the region, largely by the English from India. These chapters are more in the nature of detailed chronicles of progress, often so condensed that the thread of the discussion cannot readily be followed without almost constant reference to the two appended maps.

The illustrations are good and well chosen; and an exhaustive bibliography of "Further India" is found in the appendix. The book is decidedly readable, not only for one interested in the history of exploration but also for the general reader and for the seeker after information about a country concerning which too little is generally known.

W. S. T.

COMPTON, HERBERT. *Indian Life in Town and Country.* Pp. 281. G. P. Putnam's Sons, New York, 1904.

This volume in the series of Life in Town and Country of different nations has a distinct flavor of its own. Few books on India or any country give to the reader a more genuine feeling of experience than does this book by Mr. Compton. In rather a marked degree one feels that he knows the country in both its lights and shadows, from the native standpoint and also from that of the Anglo-Indian.

The overwhelming conservatism of the natives that makes them still cling to the "customs" and methods of the past is strongly emphasized, and Kipling's "You cannot hustle the man of the East" seems to be proven true. The presence of a Singer sewing machine more deeply accentuates the rule to which it is the proverbial exception. That the Brahmins find their greatest safeguard in custom is demonstrated, and it is truly said that "Custom is the greatest obstacle to civilization." It would appear that from the highest to the lowest caste the practice of "dustoorie" might give points to the givers and takers of "graft" in our country, for longer use has perfected their system.

The information regarding the food of the native soldiers is another side light on the theory held by Dr. Chittenden that people are fed too much and that soldiers and all could do better work, both physical and mental, on a diet more limited in quantity. The excellency of the Sepoys on their vegetable diet suggests the success of the Japanese.

The life of the native women is pictured in the same dark colors that are always given and one is driven to believe that "Women's wrongs" in India are not imaginery, but very real. The contrasting lives of the women of the "Zenana" and the nautch-girls seem both equally hopeless.

The chapter on the "Golden East" dissolves the idea of universal luxuriance in India: it is very disillusioning to read that, "Take it, square mile for square mile, and it is infinitely more barren than fertile." Such truths are most valuable, however, to give a just conception of a country. It is ridiculous that travelers should present only the fertility of a great valley or seaboard and leave unmentioned the almost endless desert tracks.

Regarding the English education of the Indian, the sentence by Mr. Compton, "The moral I would draw is that Western education grafted on Eastern character is an impossible combination," seems very pregnant, coming as it does from a man whose official service has kept him for the largest part of his life in an eastern colonial possession. Nevertheless, his conclusions regarding England in India are summed up in his statement, "What the English have accomplished in India must ever be the best monument of their right to be there."

The treatment of the Christmas problem brings a sympathetic smile to us in far America. The fact that the custom was brought by the English seems in no way to ameliorate its terrors.

From beginning to end the book is extremely interesting, giving that greatest charm of a sense of experience. A good map of India would, as always, add to the value of the volume.

Mr. Compton balances the good and ill for Indian and Anglo-Indian, but through the narrative there runs a sombre strain that leaves one with the thought that life is sad, and that, whether one knows the country as resident or as traveler, he cannot escape such knowledge.

MARY S. HOLMES.

DODGE, R. E. *Advanced Geography*. Pp. xix, 333. Rand, McNally Company, New York. 1904. $1.20.

In the words of the author's preface, "The first part, called the 'Principles of Geography,' treats of those phases of general geography which are necessary as a foundation for an intelligent and disciplinary study of the several continents from the causal standpoint." The different principles, however, do not appear to be balanced—for example, "sinks," a minor feature, are accorded about the same space as mature valleys, while to river meanders is given more space than to the whole description of mountain forms. The arrangement, also, is open to question. Thus the treatment of the lands is followed by chapters on the atmosphere, wind systems, rainfall, oceans, waves and tides, finally returning to the lands again in shore forms and glaciation. Again, in the chapter on rivers, a paragraph on sinks is literally dragged in between mature river valleys and flood plains in mature valleys, while they are not mentioned in connection with ground water and limestone caves; and monadnocks and fjords are treated under "Rivers," with no mention of either under mountains and glaciation. The illustrations in Part I are good, though too often little or no reference is made to them in the text.

In Part II "the object has been to show the relative commercial importance of the leading countries, the interrelation of the different countries commercially and the reasons therefor." The abundant use of illustrations and maps, some not commonly included in geographies of this grade, have done much to help attain these ends. The causal relations are made prominent in most cases and make this part of the book worth while as a commercial geography for pupils of the middle grades.

Not the least valuable part of the book is the appendix, with tables, especially those of the principal products, ports, and exports and imports of the leading commercial countries; an index and pronouncing vocabulary; and perhaps best of all, the rather full list of collateral readings.

W. S. T.

DODGE, R. E. *Elementary Geography.* Pp. 231. Rand, McNally Company, New York. 1904. 60c.

Part I, "Home Geography," might more appropriately have been called "general geography," since it aims to introduce not only the different types of land forms by illustration and by definition, but also to tell much about the processes by which the forms were produced. Part II, "World Relations and the Continents," treats the different countries of the world, the United States most extensively, with an account of the main physiographic features and something about the climate, resources and commerce. For the United States there are numerous instructive maps, including relief, political divisions, and resources; while for the continents the representation of altitudes both in relief and in colored maps gains little by the duplication.

As a geography for beginners, there is perhaps an excess of definitions and use of terms in Part I; but, this defect is partly offset by the really good accompanying illustrations, to which, however, more notice might well be given in the descriptions. Occasional unhappy phrasings of sentences mar a generally useful text, in which the chief merit lies in the constantly emphasized relation between physical conditions and the life of the regions.

W. S. T.

GANNET, GARRISON AND HOUSTON. *Commercial Geography.* Pp. 410. American Book Company, New York, 1905.

A satisfactory text-book in commercial geography is a difficult pedagogical problem. There have been many attempts of late by able and learned men. The American Book Company now essays to take the field by the presentation of a book which may almost be called the product of a corps of editors. It bears the title of "Commercial Geography," by Gannet, Garrison and Houston,—Henry Gannet, geographer, United States Geological Survey; Carl Garrison, Washington, teacher of experience, and Edwin J. Houston, the veteran geographer of the Central High School, Philadelphia. The book has been some years in preparation and has been worked on by persons whose names do not appear on the title page.

Being a joint product the book reflects the emphasis of several minds, and is wonderfully rich in the amount and variety of information contained in its 410 pages. It has, as should be expected from its authors, more *geography* than such books usually contain. The usual order is followed and the book opens with a discussion of products and countries. Much attention is given to maps, some of which cover rather unusual fields. The book is more academic than practical in some respects, as evidenced by a cut of a blast furnace of a type that was becoming antiquated at the time of the Civil War.

The world is so large and the limits of a text-book so small that the treatment of countries, like that in a gazetteer, must be brief, so brief that the student is likely to be compelled to remember rather than understand. As a problem in pedagogy, the editors of the Bulletin would, I am sure, welcome the opportunity to know the experience of teachers who have atempted to interest and instruct students by the use of such a book. Is it a success? It is the feeling of the writer that we have a good book of the kind, but that the kind is unsatisfactory.

J. RUSSELL SMITH.

University of Pennsylvania.

HOGARTH, DAVID GEORGE. *The Penetration of Arabia.* A record of the development of western knowledge concerning the Arabian Peninsula, with illustrations from drawings, photographs and maps by J. G. Bartholomew. Pp. 359. Frederick A. Stokes Company, New York, 1904.

In presenting to the public his book on "The Penetration of Arabia," the author disclaims any personal participation in such exploration, offering the fascination of the subject as a plea for the production of the volume, but he is no less to be commended for his painstaking compilation of the achievements of others. Such a large territory as is comprised in Arabia has been and still is comparatively unknown, for, from its geographical conditions, with no continuously cultivated regions, it has a peculiarly prohibitive character. Despite this, however, explorers of various nationalities, either sent as political emissaries or men prompted simply by their own curiosity about the "Island of the Arabs," have been the pioneers to see and describe this singular land. The list of these even is not long, but on it may be found the names of Niebuhr, Seetzen, Burckhardt, Wallin, Burton, Palgrave, Halévy, Doughty, Blunt, Huber, Euting, Hurgronje and Glaser. Each in turn has told his tale of adventure and drawn a map of the tract over which he has wandered. Naturally, these maps do not always agree, and the shifting of the position of watercourses on them, for instance, is not to be wondered at when considering the different times of year the journeys have been made and allowing for the increase or diminution of such a variable element; and distances when measured by camel marches cannot always be accurate. In the main, however, from all these accounts, a general idea has been gleaned of inland

Arabia, with the exception of the south center, which still remains an unexplored region: a tract of half a million square miles, which may be in part a great sandy waste, or may contain a central lake, as thought by Chedufau, with fertile spots and mountain ridges. But all this is mere conjecture.

What is definitely known is the result of the reports of the earliest geographers made specifically intelligible by the more scientific observers of the nineteenth century, who, often robed as pilgrims, have thus been enabled to join caravans through the rainless country and visit the holy cities, make notes as to plateau, elevation, volcanic tract, sand dune of the desert, oasis and torrent stream, and, thrown in contact with the nomad Arab, have been able to furnish the world with details of the social life of the finest race of the Caucasian type.

LAURA BELL.

KING, CHARLES F. *Elementary Geography.* Pp. iii, 220. Charles Scribner's Sons, New York. 1904.

"A textbook for children" (of primary grades) in four parts, told in a personal narrative style. Part I, "Home Geography," aims to create the practice of observation. With this power developed the children are taken in Part II to geography through type forms, as a mountain, a river, a valley, a prairie. Part III treats the earth as a whole, and Part IV, "Journey Geography," carries the description through many of the better known, rather typical, parts of the several continents.

The order of Parts III and IV might well be reversed to preserve the plan of working out from the local to the larger fields. Illustrations are abundant, good, and perhaps best of all referred to in the description. Not a few, however, might be omitted with little loss to the whole. Questions accompanying the text leave opportunity for the teacher to supplement with others. Good political maps of the continents and of separate groups of States in the United States show also the large features of relief, but still retain the unfortunate exaggeration of the width of rivers.

Though both in text and illustrations less emphasis on cities might be desirable, the book as a whole teaches by object rather than by definition—certainly the right method for young children. Perhaps the best estimate of its value is in the use of the roadside gully to teach stream action.

W. S. T.

KNOX, GEORGE WILLIAM. *Japanese Life in Town and Country.* Illustrated. G. P. Putnam's Sons, New York and London, 1905.

In order to comprehend the Japanese character it is necessary to live among the people and try to understand their attitude toward other natons by reviewing their history and surroundings: to judge their attainments by the standard of Oriental customs rather than by our own. This has been done conscientiously and successfully by Dr. Knox in his "Japanese Life in Town and Country," and his residence of fifteen years in Dai Nippon has furnished him with many opportunities to acquaint himself with our Asiatic neighbors. Tracing their origin from earliest known records, the Japanese have always been intrepid fighters and possess a wonderful faculty for adopting superior civilizing influences. They still retain, however, the various forms of religious belief introduced from China and India, and the position of woman in their country remains as a great blot on the social structure of Japan.

Dr. Knox discusses Buddhism and Confucianism at length, defining the former as the religion of the common people and the latter as the religion of the educated. The spirit of old Japan, of which the sword is the symbol, is well shown in his chapters on the Samurai. The student of human nature is made to see how their early training fitted the Japanese for modern warfare as well as for that of earlier times. Social customs and life in all classes being well portrayed both in the text and by numerous illustrations, one lays down the book with a more intimate knowledge of the Japanese and with the distinct impression that they must in future be counted in with other powers, not to be regarded simply as curiosities nor their country to be looked upon merely as the playground of the tourist.

LAURA BELL.

McLAIN, J. S. *Alaska and the Klondike.* 330 pp. McClure, Phillips & Co., New York, 1905.

A new book on Alaska and the Klondike does not recommend itself at first to a reader, for much writing has made the subject a most familiar one, almost to the border of weariness. Mr. McLain's book, however, well justifies itself, as it takes one on a comprehensive tour of the country, by giving a report of conditions comparatively up-to-date.

"Alaska and the Klondike" is a detailed itinerary of a journey made in the summer of 1903 by a party of United States Senators, whom Mr. McLain accompanied, who took the trip with the view of ascertaining the conditions of the country for the purpose of more enlightened legislation.

No person, no matter how casual a traveler, can visit Alaska without the strong realization of the deficiency of the government of the American territory in comparison with the Canadian efficiency; a trained observer, traveling with the intention of making such discovery, becomes rich in conclusions. While Mr. McLain's book is extremely interesting and instructive, its real value lies in the demonstration of the necessity for more intelligent and conscientious legislation and administration. The advocacy of better roads, especially the one from Valdez on the Southern coast to Eagle on the Yukon, seems especially pertinent.

The book is full of information well presented. It has a neat and suggestive map, and altogether is an addition to the literature on the northwestern portion of our country.

MARY S. HOLMES.

OUTRAM, JAMES. *In the Heart of the Canadian Rockies.* Pp. xii, 466. Forty-six illustrations and three maps. Price, $3.00. The Macmillan Company, New York, 1905.

The Swiss Alps have come to be generally accepted as the yardstick by which other mountain districts are measured, and though we frequently hear the term, "Switzerland of America" employed, it is almost invariably a misnomer. The one real exception comprises the Rocky Mountain system of Canada. Twenty years ago that district was a trackless wilderness, but since the opening of the Canadian Pacific Railway has made it accessible, the region has come to be increasingly well known by nature lovers throughout the world. So far, however, there has been published no comprehensive work dealing with this most delightful district. A new book on the subject will therefore be received with delight by the increasing number of travelers who have found in Western Alberta and British Columbia a new and entrancing playground.

The present work is devoted to the Rocky Mountains proper, where the author has spent parts of three seasons, and being a climber of more than average ability, who had the advantage of being accompanied by some of the best guides, both Swiss and native, who have been stationed in the mountains, Mr. Outram was enabled to accomplish a considerable amount of original climbing and exploration. His book, however, treats also briefly of the work done by the real pioneers, Messrs. Abbot, Wilcox, Allen, Fay, Collie and others. But little that is absolutely new to those that have kept in touch with the literature on the Canadian Rockies will be found in this work, as the bulk of the matter has already appeared in print either in Mr. Wilcox's or Dr. Collie's books or in the numerous magazine articles that have been published, especially those in Appalachia, of Boston, and the Journal of the Royal Geographical Society, of London. Nevertheless, it is a very great advantage to have these more or less fugitive publications summarized, and the results presented in attractive connected form, which enables the reader to get an excellent general view of what has so far been accomplished by way of exploration and mountaineering. The story is interestingly told and some of the author's personal experiences when climbing with but one guide are decidedly thrilling.

It is much to be regretted that with the wealth of splendid material that might be secured, the illustrations of this book are far below the average of what the reader has the right to expect, and the maps are poor, especially the general one covering the whole region. This one is so badly drawn and engraved, that the important peaks are almost indistinguishable, while the very heavy red line used to emphasize the author's route quite eclipses the topography of some sections. Occasionally more care in spelling proper names, particularly on the maps, would also have been desirable. Notwithstanding these defects, the book, which has an excellent index, will be found a distinct addition to the literature of the subject.

GEORGE VAUX, JR.

Prowse, D. W., Editor. *The Newfoundland Guide Book, 1905* (Including Labrador and St. Pierre). London, Bradbury, Agnew & Co., Ltd. 8½ x 5½ inches. Price, one shilling.

To those seeking new fields of travel and sport, out of the beaten track, this guide book for Newfoundland will prove timely and instructive. Few realize the fact that, since the completion of the new railway service via Cape Breton, it is possible to reach in a three days' journey from Boston this ancient colony of Great Britain with its impressive scenery, interesting people, free salmon rivers and unequalled caribou shooting. The editor, Judge Prowse, the historian of Newfoundland, has condensed in this little work much information relating to the history, trade, commerce, fishing and shooting of the island. In the preparation of the book, he has had the co-operation of a number of English travelers or officials whose contributions are of unequal merit. Considerable space is devoted to the sporting possibilities of the island. Thus a full description is given of the salmon and trout rivers, and a list of hotels and guides is appended, together with full information as to the best places and methods for seeking the caribou. One of the best chapters is contributed by the surgeon-missionary, Dr. W. Grenfell, who treats of the varied attractions of the Labrador coast to the scientific explorer, sportsman or tourist. The guide book is well illustrated and provided with a map.

Henry G. Bryant.

Russell, Israel C. *North America*. Pp. x, 435. Maps and diagrams. D. Appleton & Co., New York, 1904.

This important work is one of Appleton's World Series (The Regions of the World), edited by H. J. Mackinder, M. A., reader in geography in the University of Oxford. That the book is issued by the Appleton's attests the general typographic excellence of the printed pages, maps and illustrations. The interest of the reader is held throughout the 425 pages of text.

Some chapters are stronger than others, in fact are masterpieces, especially those devoted to physiography and geology in which Professor Russell is an acknowledged authority. The first two chapters condense in a very readable statement the latest facts concerning the margin of the continent and the topography of the land. The first chapter, dealing with the continental margin, presents the most important recent discoveries about the past and present history of the continental shelf, of what that shelf is composed, of the submerged river channels which trench the surface of the submerged shelf in deep cañon like depressions. A statement, as to the marine, animal and vegetable life of this depressed margin of the continent, adds greatly to the interest of this chapter, as does also a detailed account of the submarine topography of the Caribbean region. This by no means concludes the first chapter, for the author goes on to consider the movements of the ocean waters, the topography of the coast line, the changes in the coast line due to waves and currents, the changes in the coast line due to oscillation of the land, the action of ice and the deposits made by streams.

In the second chapter, Professor Russell considers the topography of the land in connection with the chief geographic features, viz.: the Atlantic coastal plains and plateaus; the Atlantic mountains, the Continental basin, and the Pacific Cordillera, or in less technical language the Pacific mountains. Many facts of great interest are presented in this chapter, which enchains the attention as much as the first.

The third chapter on climate is a compilation and statement of the principal elements of the North American weather that go to make up the average conditions of the atmosphere embraced in the broader term climate.

The fourth chapter on plant life is an interesting statement of the distribution of North American plants and the several physiographic regions, but to the reviewer, who has recently completed a plenary treatise on this subject, this is the least satisfactory chapter of the book, and goes to prove that scientific work is so highly specialized, that no one man, however broad his training, can cover satisfactorily the whole field. The fifth chapter on animal life is an extremely interesting one, but the author, not claiming originality, has borrowed his classifications of realms, zones and regions from several sources, so that the chapter lacks that uniformity of treatment which the chapters on physiography and geology possess.

Reference should be made to Professor Russell's pleasing diction, well illustrated by the following quotation from the chapter on animal life: "The winter is characteristically a season of silence. The sounds heard at a distance from human habitations are mainly those produced by inanimate nature. The wind causes varied discords amid the bare branches of the deciduous trees or sings weird melodies in the pines. Strange muffled roars come from the frozen lakes, as the ice contracts and breaks during periods of excessive cold. The frost in tree trunks causes sharp explosions. The ice-covered streams are still except where cataracts interrupt their even flow. In the profound silence of a calm winter night the distant dismal howl of a wolf, the cry of an owl, or the bark of a fox alone reminds one that life still continues, but these animate sounds are far more frequently absent than present. With the coming of the spring there is a marvelous awakening and unfolding. The brooks, swollen to overflowing by the melting of the snow, make music as they run. The northward flight of the birds brings to every grove a chorus of song. A host of batrachians and reptiles bestir themselves after a long winter sleep and vociferously proclaim their presence. The insect world with its unnumbered legions, takes wing. The air vibrates with millions of voices. The trees put forth their leaves, each a harp-string which responds to the touch of the fingers of the wind. The organ notes of the thunder again startle the hibernating echoes."

The concluding chapters on geology (Chapter VI), the aborigines (Chapter VII), political geography (Chapter VIII), are all freighted with instructive and important facts concerning the rock strata, their succession, and the peoples and political governments of North America. A bibliography accompanies each chapter.

JOHN W. HARSHBERGER.

University of Pennsylvania.

TARR, R. S. *New Physical Geography.* Pp. 457. The Macmillan Company, New York, 1905.

Profesor Tarr has had a successful experience as the author of textbooks in physical geography. His first book in "Physical Geography" and his "Elementary Physical Geography" have had a deservedly large sale. This year he has published a "New Physical Geography" which is, in some respects, a disappointment.

In the introduction he states that he has solicited and received the advice of many teachers and has tried to incorporate the best results of this advice in the new book. According to the writer's feelings, he has taken too much counsel. He adopts in the book the German pedagogical scheme of repetition. After every subject he mentions a great many of its possible connections with extreme brevity, so that after the student has used the book a little while, there is nothing new in it and the freshness of opening a new field is gone. A sentence in one chapter has introduced a paragraph in another and the student says, "I know this." The whole book is extremely brief and it has in addition to brevity a restatement, a summary, at the end of almost every subject. It is very difficult for a student to grasp a whole new idea in all its fullness when stated in two or three short sentences.

An analysis of one chapter selected at random shows the following: Pages 137-159 inclusive, deal with glaciers. In these twenty-two pages there are three pages of questions at the end, and one-half a page of references, six illustrations and sixteen summary statements. One page possessed two summary statements, a large illustration, with three lines of description under it; leaving as the text contribution of that page eighty-four words, which had a rather surprising summary embracing thirty-four words. The pages when full are small.

The book might almost be called "Teaching by Pictures." This same chapter on glaciers contained 22 unnumbered pages devoted entirely to illustrations and maps which had the combined number of forty-four, these too in addition to the six illustrations in the text.

J. RUSSELL SMITH.

DAWSON, S. E. *The Saint Lawrence. Its Basin and Border Lands.* Pp. xxii, 451. New York: F. A. Stokes Company, 1905.

Following an increasing tendency toward detailed studies of definite areas, this book makes a desirable addition to the class of semi-popular, semi-scientific treatises on geographical history. The St. Lawrence region is the nearest portion of the North American continent to Europe, and is of special interest as being the first part of the main continent to be reached from the Old World. It is especially fitting, therefore, that among the first of the geographical-historical studies of North America should be this "attempt to set forth in order the chief facts relating to the discovery and exploration of the northeastern part of the continent of North America."

The area covered in the study of the St. Lawrence region extends from the mouth of the Penobscot, in Maine, to Cape Chidley, the northern point of Labrador. It represents about seventeen degrees of latitude along the Atlantic coast, and covers the areas comprised in Newfoundland, Nova Scotia, Cape Breton Island, New Brunswick, the St. Lawrence valley proper and the region of the Great Lakes.

The account opens with a geographical sketch of the country, giving a general survey of the more prominent and important physical features of the entire region discovered in the many voyages of the different explorers, whose deeds are recorded in subsequent chapters. These descriptions of physiography are, perhaps necessarily, made rather shorter than might be desired, giving only general features—as surface character, elevation, chief rivers, etc. But frequent reversions to the physical features in subsequent chapters makes the element of geographic influence more prominent than is often the case in books of this character.

A second introductory chapter appears perhaps unnecessary for the subject of the book. Yet, dealing as it does with the early condition of geography, ancient concepts and charts of the world, and the beginning of exploration and discovery, it can hardly fail to be of interest to the average readers, to many of whom much of it will appeal as for the first time.

The real account of the St. Lawrence region begins with the voyages of John and Sebastian Cabot. Accounts of other voyages and claims follow—as the various ideas of mythical discoveries previous to the voyage of Columbus; the Portuguese discoveries during their "golden age" of maritime activity; the voyages of pirate adventurers after the time of the Cabots, and the voyages of John Rut, Hore, Verrazano and Gomez. These records are all interesting as illustrative of the rapidly growing enthusiasm for exploration and discovery; but are still more significant of the dominating idea of exploring the American continent, not for itself alone, but with the one view of finding a through passage to the "South Sea," "Cathay" or "the Indies," as the goal of European commercial ambition was variously known.

These voyages bring the history of exploration up to the time of Jacques Cartier's appearance in 1534. By that time the whole Atlantic seaboard of the Dominion of Canada had been explored by the combined efforts of the different adventurers. The St. Lawrence Gulf, however, was still regarded as a bay, and the St. Lawrence River was unknown, though conjectural rivers flowing into the bay were represented on the charts of the time.

Cartier, like his predecessors, was commissioned to find a passage to Asia. And it was for this first one of the great French explorers to find his way into the broad mouth of the St. Lawrence, penetrating as far as the site of Montreal, and preparing the way for the stream of French explorers who were to follow. Cartier stood in the front rank among the early explorers; by his three voyages, opening up the broad country of the Lower St. Lawrence. Yet nowhere, it is interesting to note, has his name been left as a landmark of what he did.

Following the efforts of Cartier come the stories of late exploration, the voyages of Roberral and Champlain, of the many Jesuit fathers, of Jolliet and La Salle, of Hennepin and Dulhut, of Marquette, of Nicollet and of others, all of whom pushed the limit of the unknown country farther toward the west.

This detailed recounting of the different steps in the exploration is interesting and valuable as giving a more thorough conception of the opening up of the continent than can be had from ordinary histories. The accounts are detailed enough to include the contributions of men unknown even by name in the usual general treatise. The elemnt of physical conditons met with and overcome is clearly presented in almost every case, and, above all, the story of discovery, of history and geography combined, is told in an attractive way.

As interesting as are the chapters giving the account of exploration, yet perhaps even more interesting to the average reader, is the account of the occupation of the St. Lawrence region, as told in the closing chapters of the book. For in this occupation was foreshadowed the conditions which were to influence the history of the American continent for many years to come. And in this history the geographical influences were to be of prime importance.

Following up the broad avenue of the "River of Canada," the French pioneers had outflanked the barrier of the Alleghenies, the "endless mountains," which so long retarded discovery at the south. They had pased readily up into the great fresh water seas in the heart of the continent and over the portages at the heads of their tributaries into the adjoining basins at the north, the west and the south, unlocking all the river communications of the interior.

The era of discovery closed with the seventeenth century, the subsequent history of the region being a history of the conflict for possession of the valleys, in which the waterways and portages were the strategic keys to the country. The closing chapters of the book deal with the main events of this occupation.

The book contains many good half-tone illustrations and a map, in colors, of the St. Lawrence region. A valuable bibliography adds another desirable feature to a very satisfactory whole.

W. S. T.

CROSBY, OSCAR T. *Tibet and Turkestan.* Pp. xvi, 331. New York: G. P. Putnam's Sons, 1905.

In presenting his book to the public Mr. Crosby adds one more to the growing series which deals with Central Asian conditions and things. His way of approach is different from some of the others, but the ultimate destination is the same as that of Hedin, Landon, Younghusband and others, whose accounts are already familiar—Tibet—the land of the unknown a half decade ago.

The first few chapters are devoted to the incidents and points of interest on the journey across Túrkestan. In the author's words, the route was as follows: "Starting at the Caspian Sea, we went by rail eastward through Russian Turkestan to Adijan; thence by caravan over the Trans-Alaï Mountains to Kashgar, in Chinese Turkestan; thence, skirting the Taklamakan desert, through Yarkand and Khotan to Polu, a village on the slopes of the Kuen Lun Mountains; thence up to the Tibetan plateau, whose northwest corner we explored, passing through the unknown region called Alsai-Chin; thence out through Ladak and Kashmir to Rawal-Pindi, on the railway; thence to Bombay." An appended map shows the author's route as here delineated. Numerous illustrations in the text show points of interest along the way. In general, the illustrations are well reproduced, but to many a reader there cannot help coming the silent wish that on such journeys the object of the photographer's zeal might be more often the aspects of an all too unfamiliar landscapes, and less often people and places practically duplicated again and again.

The rest of the book is devoted to a discussion of Tibetan conditions —the people, their religion, industries, arts and history, followed by the chief items in the political situation. It is impossible in a brief review to call attention to particular items of interest—it must suffice to say that the portrayal of these conditions has the interest always found in a heretofore "undiscovered country."

There has apparently been no intention on the author's part to make the book of scientific merit, after the manner of Hedin's valuable work. At times there is an unmistakable feeling that a more serious, or perhaps rather more dignified diction, would have been better pleasing. A less extravagant or more skillful use of adjectives in attempting to draw effective word pictures might have aided in securing the desired result.

Some fifty odd pages of appendix seem somewhat out of proportion to a volume of this size, devoted as they are mainly to the political conditions.

As a whole, however, the book is easy and attractive reading—worth the while for the reader who seeks a few evenings' entertainment not entirely devoid of profit.

W. S. T.

HATCH, ERNEST F. G. *Far Eastern Impressions. Japan-Korea-China.* Pp. xiii, 257. Chicago: A. C. McClurg, 1905.

As the title suggests, the book sets forth the impressions received by the author during a tour through the three countries named—Japan, Korea and China. The writing of the book, like many others dealing with the same countries, was prompted by the outbreak of the Russo-Japanese war. But, as the notes were collected on a journey previous to the outbreak of the war, some of the conditions noted, impressions gained and speculations and conclusions based on them, are no longer applicable in the light of subsequent developments.

The conditions dealt with are chiefly social, industrial and political—the last two receiving by far the greater share of attention. Most of the book is devoted to the impressions made by Korean and Chinese conditions, only the first two chapters being devoted to Japan. The political aspects contain nothing new to the person who has in any degree followed the development of affairs in the Far East.

The chief interest and value of the book lies in the exposition of the rather less widely known industrial conditions—the resources, the possibilities of development, and some of the progress made, mainly through concessions to the great powers of the world.

The book is well written, with some good, and not too well known, illustrations, and is interesting as a whole even to the reader who is already familiar with many of the conditions described. But it belongs withal in the class of elaborated traveller's journals, rather than with the books which add to the actual store of information about the region.

W. S. T.

WIBORG, FRANK. *A Commercial Traveler in South America.* McClure, Phillips & Co., New York, 1905.

This short sketch of a flying trip along the South American coast from Panama to Valparaiso, crossing the Argentine plateau to Buenos Ayres, and thence up the eastern coast, is filled with interesting and instructive notes from the standpoint both of the traveller and of the business man. It shows that the difficulties of the trip are not great, and tells how little we have used this country for either exploration or business.

T. LE BOUTILLIER.

Recent Accessions to the Library of the Society

AFRICA.

EGYPT .... WARNER

My Winter on the Nile. By Charles Dudley Warner. Boston: Houghton, Mifflin & Co., 1881. *Presented by Mrs. Amos R. Little.*

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Incised Meandering Valleys.

W. M. DAVIS.

Some years ago Winslow called attention (*Science,* July 21, 1893) to the widening of the meander belt when a serpentine river is impelled by regional uplift to erode a new valley below the level of its earlier valley floor; he suggested that during the process of vertical and lateral corrasion thus initiated a pronouncedly meandering course might be developed by a river whose previous course was but of moderate sinuosity. Had meanders previously existed, they would be enlarged by lateral corrasion during incision. As a consequence, an incised meandering valley might be expected to exhibit rounded spurs whose slope, more or less gravel covered, would show where the river had withdrawn laterally or "slipped off"; and corresponding concave amphitheaters, where the river had encroached on new ground and "undercut" its valley sides, as in Fig. 1. The slip-off slope might therefore be taken as a measure of lateral corrasion. The points, A A A, on the axis of the spurs where the upland ends and the slip-off slope begins would appear to mark the vertices of bends in the river, developed in a previous cycle of erosion, before the occurrence of the uplift by which the incision of the new valley was impelled; and the difference of breadth of the meander belts, one enclosed by a pair of lines through the upland spur-end points and the other by a pair of lines tangent to the actual river curves, would seem to measure the widening that the meander belt had experienced during incision. But the pattern of Fig. 1 is unnaturally symmetrical; it needs modification of a kind shown in the following figures.

A revived river corrades vertically; if this action alone occurred, the trench cut by the river would have the same pattern, when seen in plan, as that of the river before revival. The river also corrades laterally or saps the outer bank of its curves, as stated above; as a result, its curves tend to increase their radii, as shown in Fig. 1. But the river at the same time corrades or saps laterally to a greater or less degree the down-valley side of the arms or tangents between its curves, and thereby the whole system of curves slowly migrates down-valley-ward (*Science,* July 12, 1901), and as a result the spurs must be unsymmetrical: they will have a steeper undercut slope on the up-valley side and a slip-off gravel-strewn slope on the

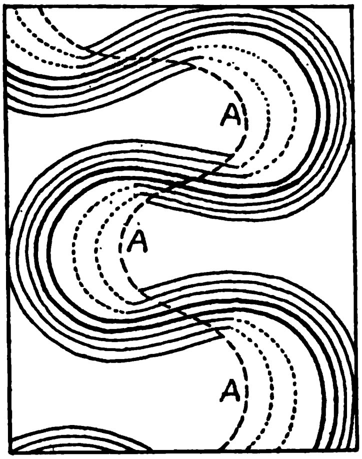

FIG. 1.

An incised meandering valley, without down-valley migration of meanders.

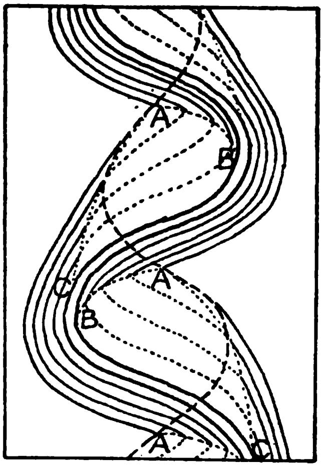

FIG. 2.

An incised meandering valley, with down-valley migration of meanders.

down-valley side. When the river reaches grade and vertical corrasion practically ceases, a continuation of the two processes of lateral corrasion results in the systematic development of flood plain scrolls; at first in narrow strips, then wider and wider; but this element of the problem is apart from the object of the present paper and need not be further considered here.

The rates of corrasion (vertical, lateral-outward and lateral-down-valley-ward) vary absolutely and in relation to one another. Their controls have not been well worked out. The total vertical corrasion is limited by the altitude given by uplift: the lateral-outward corrasion is interrupted where cut-offs occur, but it begins again as new curves are formed, and continues in this intermittent manner through maturity; it may thus, as in the case of the Mississippi, give the flood plain a much greater breadth than the meander belt. Down-valley-ward corrasion is also interrupted where cut-offs occur, but it reappears as soon as new curves are developed. In the earlier stages of valley erosion it is the down-valley-ward corrasion that is largely responsible for the trimming and gradual removel of the spurs, whereby a narrow incised meandering valley is converted into an open flood-plained valley.

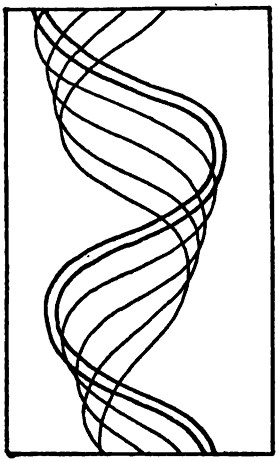

FIG. 3.
Pattern of successive positions of a meandering stream.

Certain results of the combined action of outward and down-valley-ward corrasion and sapping are presented in the following diagrams, in which the river is marked in heavy lines. For convenience of drawing, the upland is considered level and no account is taken of the slope of the river. To make the examples as simple as possible, the action of branch streams in cutting side ravines is not taken into account. The length of each diagram from top to bottom may be taken as from two to four miles; the contour interval may be fifty feet; the contours are drawn in broken lines on the slip-off slopes and in full lines on the undercut slopes.

It has already been pointed out, in describing the incorrect diagram, Fig. 1, that the vertices of the river curves, as developed in the preceding cycle of erosion, would appear to be indicated at the points A A A on the axis of the spurs, where the upland ends and the slip-off slope begins. If this guiding principle were accepted as correct, it would appear in Fig. 2, which is a much nearer approach to natural conditions than is Fig. 1, that the river had a direct course when incision began, because the upland spur-ends A A A are here in a straight line. But this is an error; for even if gravels occur far up on the slip-off slopes, the river course must originally have had pronounced meanders, as indicated by the broken line. This is proved as follows:

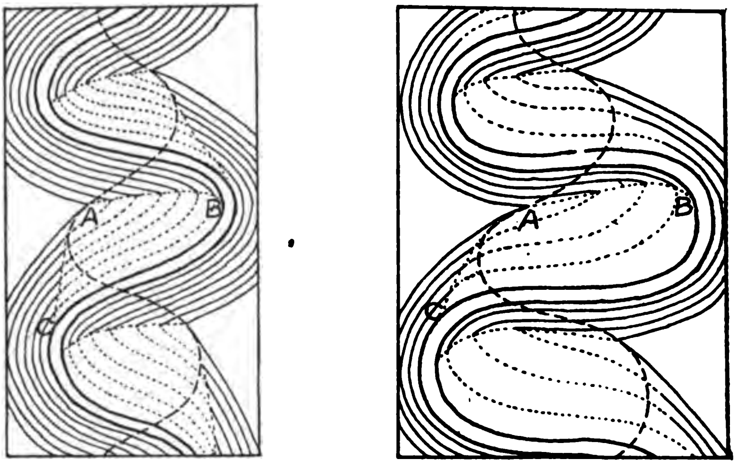

FIG. 4. FIG. 5.

Different types of incised meandering valleys.

The occurrence of bedded gravels on the slip-off slopes (dotted contours) shows that no significant erosion has taken place on those slopes since the river withdrew from them. Hence each contour line on such slopes marks (approximately) a part of the river course at a certain stage of incision. Records of the other parts of the course have been destroyed by undercutting, but they may be restored sufficiently well for present purposes by interpolating curves between corresponding (dotted) contours, and they are so restored in Fig. 3. The original river course may in this manner be reconstructed with some approach to accuracy, and shown to be distinctly meandering or serpentine. It is thus found that an upland spur-end by no means marks an original bend in the river, corresponding to the enlarged bend by which the river now swings around the base of the same spur. In Fig. 2, the upland spur-ends touch tangents between the original bends or meanders. In Fig. 4, where greater depth of incision is assumed, the spur-ends approach the apices of former bends that turned on the upland level directly away from the existing meanders at the base of the spurs: here the spur-ends of the opposite uplands do not extend forward far enough to reach an axial straight line. The slip-off slopes may have a large area of gravel cover; nevertheless the original river course was distinctly meandering.

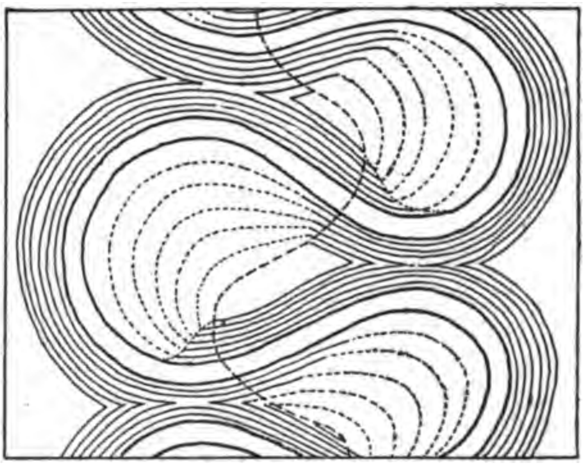

Fig. 6.

Incised dovetailed meanders, with upland remnants on spur heads.

The significant features in these examples are the two lines that separate a slip-off slope from the undercut slopes next up-stream and down-stream. If the analysis here presented is correct, the line A B, Figs. 2, 4, 5, between the slip-off slope and the next up-stream undercut slope runs along a fairly well-marked salient edge, which the contours turn around in a distinct angle: the line A C between the slip-off slope and the next down-stream undercut slope follows a concave reentrant less distinct than the salient edge. If we examine any single spur, it will be seen that the undercut slope comes to the salient edge from the preceding amphitheater with full height to the upland spur-end, and then tapers down to a point at the stream near the apex of the spur base; the undercut slope begins in a point at the upland spur-end, and widens into the following amphitheater, where it reaches down to the stream. Scattered or creeping gravels and pebbles may occur on the undercut slopes, but orderly gravel beds are not to be expected there.

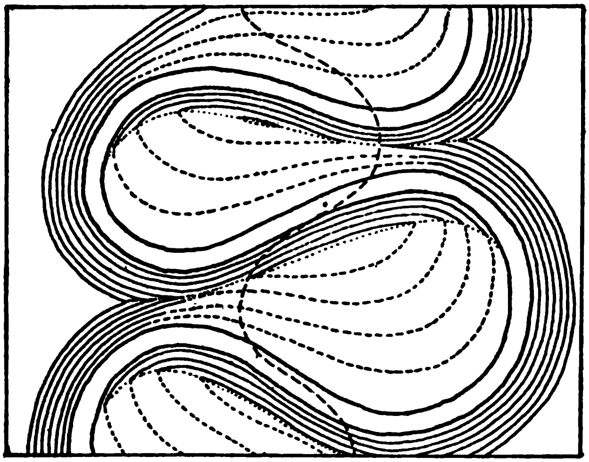

Fig. 7.

Incised dovetailed meanders, without upland remnants on spur heads.

Fig. 5 shows a greater widening of the meander belt than Figs. 2 and 4. Figs. 6 and 7 represent exaggerated or dovetailed meanders. The original and the present river courses are the same in these two figures; but in the second a greater amount of down-valley-ward corrasion and shifting is shown than in the first. In the first, the spur necks are narrowed and somewhat lowered, and the isolated patches of upland on the spurs suggest an originally meandering river; in the second these indications of original meandering have been undercut and destroyed, and here, as in Fig. 4, an original bend curved towards a present upland spur-end, not away from it.

The degree of preservation of upland spurs that enter the river curves depends not only on the rate of down-valley-ward migration of the meanders and on the time that has elapsed since incision began, but also in the depth of incision, as is illustrated in Fig. 8. Here the stream makes six curves to the east and six to the west; but at the margin of the upland, the salients or cusps are only four in number and these four are much less pronounced than the curves of the stream. The reason is obvious: the convex spurs are like parts of cones with vertex upwards, vanishing at the apex; the concave amphitheaters are like parts of cones with apex downwards, and consequently with increasing dimensions upwards. The spur-cones are therefore consumed by the amphitheater cones; the edge of intersection D F, Fig. 9, of two adjoining amphitheater cones will (down-valley migration of curves being neglected) bisect the tangent B C to the stream curves above which the amphitheaters rise (on the assumption that the curves are of equal radius). Consequently, if the first and third of three stream curves A B C depart more from the valley axis than the intermediate curve does, the amphitheater cone D E F of the intermediate curve will soon be encroached upon and consumed by the cones of the other curves, A and C, as is illustrated in the figure. Still further, the greater the depth of incision the larger the radius of the contour line arcs at the edge of the upland and the smaller the angle there subtended by them, and hence the less pronounced the salient upland cusps. The result of all this is that when the depth of incision is relatively great, as in Fig. 8—about as great, for example, as the breadth of the belt that contains a pronounced system of meanders—there will be but little resemblance between the upland margins and the stream curves, and the degree of meandering possessed by the stream before incision began must be determined, if determinable at all, not by the pattern of the upland margins, but by building upward from the contours on the slip-off slopes of the spur cones.

Topographical maps are rarely accurate enough to exhibit all the significant features here considered: they might be more generally accurate if the topographers had time and knowledge to look carefully at the critical points when in the field, and if the draftsmen and engravers preserved the critical points in the office. At present the student of meandering valleys must go into the field for facts. When in the field he may find it of advantage to look for the salient edge that descends from the upland spur-end to the spur-base and to note carefully the pattern of the contour lines on the slip-off spur slopes, as a means of restoring the original curve of the river.

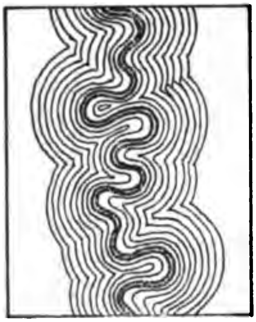

FIG. 8.
The deep valley of a small meandering stream.

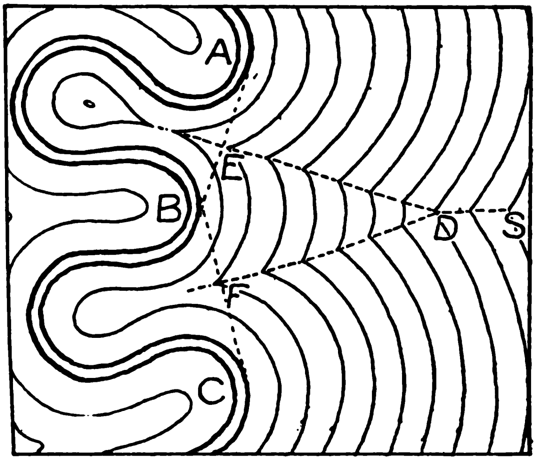

FIG. 9.
Detail of the deep valley of a small meandering stream.

The more symmetrical curves of the Raystown branch of the Juniata river in Pennsylvania (Huntingdon topographic sheet, U. S. G. S.), may be typified in Fig. 7. The widening of the meander belt and the down-valley migration of the meander system are distinctly shown. The depth of incision is 200 feet or more; the slip-off slopes on the ends of the spurs often measure 1,000 or 1,500 feet; the slip-off slope on the down-valley side of several spurs is as much as 2,000 feet. A number of the meanders have enlarged their radius of curvature to the point of gaining a dove-tailed pattern, as a result of which the necks of the spurs sag a little, as in Fig. 7. This example is a good one to show the incorrectness of the statement sometimes met with to the effect that rivers do not begin to cut laterally until they have ceased to cut vertically. In this case, as in many others, lateral cutting accompanied vertical cutting, and was indeed of greater amount than vertical cutting. The valley in which the meanders are here incised is of a regular monoclinal structure with steep dipping strata between a large anticline on the west and a large syncline on the east: hence the meander curves cannot be ascribed to a control by irregular rock structure, as has been suggested in certain cases.[1]

The North Branch of the Susquehanna, in Pennsylvania, north of Wilkes-Barre, exhibits incised meanders of a pronounced curvature, with distinctly unsymmetrical spurs, like those of the Juniata, but of larger pattern. In a general view down the valley from a commanding point on the upland, the steep and wooded undercut sides of the spurs give the valley an unoccupied appearance. When one looks up the valley, the slip-off slopes of the same spurs show a series of cleared and cultivated fields. This district is not yet included in the topographical sheets, but I visited it with a party of students several years ago, and found its features were typically developed.

The Potomac river (Pawpaw sheet, U. S. G. S.) exhibits some well-defined incised meanders in a valley of monoclinal strata, but here the spurs are not distinctly unsymmetrical, and hence the down-valley migration of the curves has not been pronounced. The widening of the meander belt is also proportionately less distinct than in the previous example. Why the Juniata and Potomac should differ in these respects is not yet understood.

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[1] Since the above paragraph was written I have had occasion while conducting the Pennsylvania week of the Intercollegiate Appalachian summer course in geology in July, 1905, to visit this meandering valley, and can testify to the essential correctness of these statements on the ground of direct observation.

A good example of small meanders, deeply incised, is seen in the "gulf" or gorge of Chautauqua creek, where it descends the north-facing escarpment of the Allegheny plateau between Mayville and Westfield in Western New York (Westfield sheet, U. S. G. S.). The contour lines do not, however, exhibit the pattern of Figs. 8 and 9: the spurs are continued with convex contour curves up to the upland level; the amphitheaters are angular, ravine-like reentrants, as if cut back by little side streams, but how accurately the contours are drawn I cannot say. Other examples of small-sized meanders, deeply incised, are to be seen in the map of the High Eifel of Western Germany, but the maps (Karte des Deutschen Reiches, 1 :100,000, sheets 503, 504) being in hachures are not well adapted to showing the details here considered.

A few other examples from abroad may be mentioned. The valleys of the Ardennes frequently exhibit incised meanders. The Amblève makes a fine pair of turns near Nonceveux in Southern Belgium (Carte topographique de la Belgique, 1: 40,000, sheet 49), and the spurs are distinctly unsymmetrical, so that the apices of the original river bends must lie up valley from the spur axes. The Semois farther south (sheet 67) and Ourthe farther east (sheet 60) in the same district are remarkably circuitous in their incised courses, but many of the curves are of aberrant pattern, as if deformed by the influence of irregular rock structures. The Meuse has a fine pair of turns at Revin in Northern France (Carte topographique de la France, 1 :80,000, sheet 15); the decidedly unsymmetrical spurs indicate a distinct contrast between the undercut and the slip-off slopes. This example is of special interest because it has been described with partial reference to the points here considered: the alluvial deposits on the spur slopes have been recognized as proving the successive displacement of the river and a progressive exaggeration of its bends; hence it has been concluded that the river had no meanders before the erosion of the present valley (Ann. de Géogr., X, 1901, 129). But if interpreted as here suggested, a significant amount of original meandering may be inferred, perhaps as much as is indicated in Fig. 5.

Many more examples might be adduced from good maps. The examples that I have studied on the ground—such as the North Branch of the Susquehanna or the lower Seine in Normandy—accord closely enough to show that they may be trusted within the limits of representation appropriate to their scale; and they prove in most cases the systematic control of undercut and slip-off slopes in the manner set forth in the diagrams here presented; but they do not as a rule suffice to determine with satisfactory accuracy the pattern of curves that the incised river had before incision began. It is evident that more field work is needed before the problems here presented can be fully solved. Pennsylvania is well situated for such field work, for it includes several typical examples of incised meandering valleys within its borders, such as these of the Susquehanna and Juniata, above mentioned, as well as one of the most peculiar and in some respects most abnormal example of such forms, namely, the valley of the Conedogwinet, southwest of Harrisburg. This remarkable valley is abnormal in the excessive length of the parallel tangents by which its curves are joined, and in the attitude of its narrow flood plain strips along the down-valley side, instead of along the up-valley side of each tangent. Neither of these peculiar features has yet received any adequate explanation.

A Regional and Economic Geography of Pennsylvania

WALTER S. TOWER

PART I.

Physiography : The Central Province

(Concluded)

The Plateau Province

Location and Extent.

The anthracite coal region, the second district of the Central province, lies entirely east of the Susquehanna River. It is, like the Juniata region, traversed by linear ridges and intervening valleys. The anthracite region really marks the northeast limit of the Appalachian ridge belt (Map, Fig. 1), since across the Delaware River in New Jersey and New York the separate ridge character is lost as the upland merges into the Pocono-Catskill plateau. The district, although called the anthracite coal region, is not restricted to the comparatively small areas immediately underlain by the coal measures, but includes practically all the region between the Susquehanna River on the west, the Pocono plateau on the east, Kittatinny, or Blue, Mountain on the south, and the Wyoming, or Wilkesbarre-Scranton, valley on the north. A part of this area, however, the open region along the middle course of the Susquehanna, has already been described in connection with the valleys of the Juniata region. The anthracite coal region comprises somewhat less than half the central province, including the whole of Schuylkill, Luzerne, Lackawanna and Columbia Counties, with parts of Carbon, Dauphin, Montour and Northumberland. Its area is nearly 3,700 square miles, only about one-eighth of which is underlain by coal beds.

General Features.

In its general features the anthracite district resembles the Juniata region, with its narrow, linear ridges, parallel and converging, separated by longitudinal valleys. But in detail there are many distinct differences, most of which find their origin in the character and position of the strata underlying the surface. The ridges and valleys of the Juniata region are made by strata lying, in the geological section, far below the coal-bearing series; all the thousands of feet of overlying sediments having been removed during the process of peneplanation. Toward the northeast, however, the folds pitched down sharply in a series of deep troughs, represented by the present coal basins, from which they rose again quickly farther on. The larger troughs were modified by many secondary folds of less extent, often closely compressed. By this pitching of the axes of the folds, the coal measures and the closely associated strata were carried down to such a depth that they were not entirely removed by the cycle of erosion ending in the Cretaceous peneplain. Hence after the subsequent uplift, the processes of erosion had to deal with a different series of strata from that which underlay the Juniata region.

The strata associated with the coal measures resemble the series in the Juniata region in that they are of varying texture, some hard and some soft. The hard strata, however, are here represented by two ridge makers, a sandstone known as the Pocono formation and an overlying conglomerate known as the Pottsville formation—the two being separated only by a band of softer, reddish shales. In the Juniata region the division of the single ridge maker by a band of softer shale produced the double crested type of ridge as seen in Bald Eagle Mountain. In the anthracite region a similar condition on a much greater scale resulted in a double set of essentially parallel ridges. The softer valley-making rocks, on the other hand, are practically all shales, in relatively thin layers, unaccompanied by any broad limestone strata such as made the best lowlands of the Juniata country. These thin shale layers, almost everywhere steeply inclined, gave few wide outcrops to be opened into broad valleys. The complications of minor folds, giving repetitions of one or the other ridge makes, further prevented the development of the regular type of ridge and valley topography seen in the Juniata region.

Ridges.

The Cretaceous peneplain now finds its sole expression in the uniformity of ridge crests which reach heights of 1,400 to 1,800 feet above sea level and 700 to 1,000 feet above the associated valleys. An occasional rounded knob rises 100 to 200 feet above the general summit level. This general level, it will be noticed, is lower than in the Juniata region because the uplift at the close of the Cretaceous cycle was greater toward the southwest. The uniformity of crest level in any single ridge is, however, rather more marked in the anthracite region, perhaps because many of the ridges are of less linear extent, perhaps because the Cretaceous lowland was more perfectly developed there. The ridges present the features of all three types of mountains, monoclinal, anticlinal and synclinal, affording in their parallel and zigzag courses some of the best examples in the State.

Monoclinal Ridges.

Most of the ridges here, as in the Juniata region, show the typical steep-sided, narrow-crested form of the monoclinal ridge. Kittatinny, or Blue, Mountain, has been taken as the type of ridge with unsymmetrical slopes and great linear extent at a nearly uniform level. In the distance of 150 miles from the Delaware to the Susquehanna it follows an almost straight course (Map, Fig. 1), except for the deflection by the Big and Little offsets, and maintains a height of 1,200 to 1,600 feet even with a crest at times not over fifty feet wide. Most of the other ridges are of more steeply inclined strata, giving a fairly symmetrical cross profile, except where modified by a terrace. Of the symmetrical type there is no better example than Mahantango Mountain for many miles east of the Susquehanna. Terraced mountains, directly analogous to Tussey, Terrace or Dunning's Mountains in the Juniata region, are illustrated by the south slope of Second and the north slope of Peter's or Fourth Mountains, where the sandstone ridge maker is divided by a band of shale. The ridges are made all the more prominent features of the landscape because of their occurrence in a double series, separated only by a narrow shale valley (Map, Fig. 1). The best illustration of this characteristic is afforded by Second and Stony or Sharp Mountains, whose crests are nowhere much more than a mile apart in the extent of fifty miles from the Lehigh almost to the Susquehanna. The same instance may be used also as the best example of the parallelism of ridges for the longest distance. The greatest number of parallel ridges is found in the group composed of Kittatinny, Second, Third and Peter's Mountains, for about twenty miles eastward from the Susquehanna, where the distance between the crest of Kittatinny Mountain and the crest of Peter's Mountain varies less than one mile.

The converging and zigzag characters of the ridges show best along the western border, where the whole double series of ridges, made by the outcropping Pocono and Pottsville formations, loop back and forth in the most striking set of zigzags to be found anywhere (Map, Fig. 1). From Second Mountain on the south the crest loops round successively northeast and southwest as Peter's, Berry, Mahantango, Line, Little, Catawissa, Nescopec, Penobscot or Lee, and Huntingdon, Shickshinny or Bald Mountains, into the northeast corner of the State, where it merges obscurely with the northeastern extension of the Allegheny Front (Map, Fig. 1). Beginning with Second Mountain on the Lehigh at Mauch Chunk, the zigzag makes a continuous ridge, except where broken by narrow watergaps, for over 300 miles to where it passes Wilkesbarre, as Shickshinny Mountain, only thirty miles distant, in direct line, from the starting point.

Anticlinal Mountains.

The anthracite region shows no long, anticlinal mountains of the type found in the middle Juniata group, but there are somewhat irregular mountains of anticlinal structure. The most distinct of these are both known as Broad Mountain, one in Schuylkill, the other in Carbon County. Together they make the arch by which the southern and middle coal fields are separated. The first, in Schuylkill County, made by the conglomerate ridge maker, has a length of fifteen miles, a width from three to five miles, and a general elevation of 1,600 to 1,700 feet. The outline is irregular owing to the presence of minor flexures and the effects of erosion. The Carbon County mountain is about the same elevation but slightly broader and longer and more closely approaches the regular outline of the typical anticlinal ridge. It is made by the sandstone formation, and though of ridge-like form, it really marks the southwest termination of the Pocono plateau, for it is traceable east of the Lehigh, where it gradually widens and merges with the plateau surface. Other similar ridges, irregular in outline, cover much of the area of the anthracite region, acting as the division lines between the narrow coal basins, and with their complex arrangement, giving the area its irregular, broken topography.

The long, sloping noses of pitching anticlines are shown at the eastern turns of the great zigzags. The best examples are on the turns from Peter's to Berry Mountain near Williamstown, Dauphin County, and from Mahantango to Line Mountain, near Taylorville, Schuylkill County. The former is by far the best example of anticlinal nose in the State, showing not only a very perfect sloping termination, but also a broad, flat top, as high as either converging ridge, stretching across from crest to crest for a distance of twelve miles back from the actual termination. This broad mountain top represents the still unremoved portion of the roof of the anticline, which is entirely beveled off toward the west, showing the typical, steep, undermined slope down to the enclosed valley.

Synclinal Mountains.

Every one of the coal basins represents a synclinal fold, but hardly any of them show in regular outline the shallow trough-like crest, steep outer slopes and abrupt terminations of the typical synclinal mountain. This condition is the result of many local flexures by which the ridge makers have been repeated in outcrops holding up the level of the surrounding country, and also to the development of valleys on the softer coal measures infolded in each basin. The nearest approaches to the simple type are in the Lykens region between Coal and Big Lick Mountains, and in the Shamokin field between Big and Mahanoy Mountains. In both cases the steeper outer slopes and abrupt terminations—toward the west—in synclinal knobs are clear enough. But even between the closely ranged ridges the soft coal measures have been enough dissected to destroy much of the shallow trough character of the crest. In each, however, there is still trace of the original trough level 300 to 400 feet below the bounding ridges. Synclinal knobs of steeply pitching folds are well represented at the western turns of the great series of zigzags. Knob Mountain at the western end of the Wyoming Valley is perhaps the best, while the one near Catawissa, Columbia County, and at the turn from Little to Line Mountain, overlooking the Susquehanna south of Sunbury, are also good.

Valleys.

The valleys of the anthracite coal region show little of the regularity of development and well-opened-out character which is typical of the Juniata valleys (Map, Fig. 1). The contrast is largely due to the fact that the former are almost entirely formed on belts of shales, unaccompanied by limestones, while at the same time there are frequent infolded bands of the hard ridge-making formations. Very few of the valleys show the development of any general level expressive of base-leveling in a previous cycle. Only one shows a marked linear extent, this single exception being the narrow groove between Second and Sharp Mountains.

The monoclinal valleys are best developed on the soft shale strata lying between the two ridge makers. These valleys are closely analogous to Bald Eagle Valley in the Juniata region. Where a high inclination of the strata gives a narrow outcropping band of shale, the valleys are but mere grooves, steep-sided and lying deeply enclosed by the bounding ridges. The type is well shown in the valleys between Second and Sharp, Stony and Peter's, and Mahanoy and Line Mountains. In each case the valley walls, 800 to 1,000 feet high, are made by the steep, rocky slopes of the ridges, between which the valley floor is often no wider than the course of the small stream by which it is occupied.

These shale valleys show little trace of lowlands developed in previous cycles of erosion, because of their shut-in position between two high resistent ridges. Here and there, however, changes in the attitude of the strata, as a pitching fold or decreased inclination, have resulted in the narrow groove character giving way to a more open valley, as in the Lykens and the Nescopec Creek Valleys. The former is over five miles broad in its central portion and shows a very well-developed lowland at an elevation of 600 to 700 feet sloping gently toward the Susquehanna. At present the surface is broken by the valleys of Wisconisco Creek and its tributaries, which have entrenched themselves 100 or more feet below this Harrisburg, or Tertiary, peneplain level. Nescopec Creek Valley is hardly more than three miles wide, is more closely shut in by ridges, and has a less marked upland level at about 1,000 feet. It is also much more dissected by the entrenched streams.

Of the anticlinal and synclinal valleys, the only good example belongs to the latter class—the Wyoming, or Wilkes-barre-Scranton, Valley (Map, Fig. 1). It is about fifty miles long, northeast and southwest, and has a maximum width of about six miles. It has the form of a crescent, with the horns pointing to the north and the west. The outline made by the bounding ridges is regular, enclosing a valley floor at an elevation of 700 to 800 feet. This general level is much dissected by numerous streams; and is further obscured, through part of its length, by a strikingly level floor from one-half a mile to two miles wide, at an elevation of 500 to 600 feet. It is along this floor that the North Branch of the Susquehanna flows in the distance of fifteen miles from Pittston to Nanticoke. This flat floor is a special feature due to glaciation, in which connection it will be more fully discussed.

The coal basins are, in reality, structural synclinal valleys, in that each one represents an original trough. Most of the coal basins are, however, far from simple, owing to the secondary close-folding in smaller flexures. This folding has been effective in giving ranges of long hills often steep-sided and irregularly placed, with heights that may even rival those of the bounding ridges. The rugged, broken topography of the coal region, in sharp contrast with the Juniata country, is largely due to this complex system of ridges.

Rivers.

The district is well drained by three large rivers: the Susquehanna, with its continuation, the North Branch; the Schuylkill, the Lehigh, and their tributaries (Map, Fig. 1). Here, as in the Juniata region, the main streams follow courses generally transverse to the structure, illustrating the maintenance of courses acquired in, and inherited from, a former cycle. But the development of longitudinal subsequents and the grapevine pattern of drainage is less marked here as a result of the more complex structure.

The main Susquehanna from Sunbury to Harrisburg is perhaps the best example of the transverse stream. For a distance of about twenty miles south from Sunbury to Mahantango Mountain, near Millersburg, the course is across a part of the open region of the middle Susquehanna. Through this district the river flows in a narrow entrenched valley with steep sides rising 200 to 500 feet. The valley is not symmetrical, however, showing a widening out toward the west, as in the vicinity of Selinsgrove, as a result of more advanced dissection of the upland. From Mahantango Mountain southward the river makes five deep, narrow gaps in the ridges in a distance of twenty miles. The most striking of these, often taken as the types of water gaps, are through Kittatinny and Second Mountains, north of Harrisburg, both of which are hardly wider than the river bed, from which sharp cliffs rise to heights of 800 to 1,000 feet.

The best development of lateral subsequents is also shown along this western border of the region in Fishing, Stony and Clark's Creeks, flowing in practically straight courses along the narrow shale valleys between Kittatinny, Second, Third and Peter's Mountains. Farther to the north similar subsequents, as Powell's, Armstrong and Wisconisco Creeks, have developed on broader belts of valley-making strata. This latter group shows entrenched, often meandering courses, 100 or more feet below the valley upland, while flood plains are just beginning to appear in the narrow stream valleys. But none of these cases show very much development of the grapevine pattern so characteristic of the Juniata region.

The rearrangement of drainage as a result of the growth of lateral subsequents appears in the existence of numerous prominent wind gaps. Mahantango Mountain, for example, in the first ten miles of its extent east of the Susquehanna shows first a wind gap (Fig. 3, C) less than 400 feet above the valley floor while a few miles to the east, near the village known as Pillow, is a prominent water gap (Fig. 3, B). The latter, however, is entirely too broad to have been made by the tiny Deep Creek which now flows through it. Together these gaps suggest the processes of readjustment after the uplift at the end of the Cretaceous cycle. The stream which made the wind gap was diverted, probably by Wisconisco Creek, a lateral subsequent, and hence lowered its gap only a little. The other stream, the one which made the Deep Creek water gap, was farther

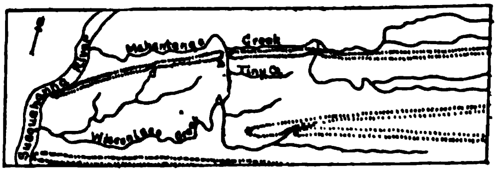

FIG. 3.

Diagram illustrating rearrangement of drainage.

away from rapidly-growing subsequent, kept its course longer and was able to cut a gap deep enough to be still occupied by a small stream. The only trace of the course of the first captured stream is the wind gap which it left. The other, however, was apparently the headwaters of the present Wisconisco Creek. For Wisconisco Creek, issuing from the narrow valley between Big Lick and Berry Mountains, instead of flowing along the trend of the strata direct to the Susquehanna, the normal course of a simple lateral subsequent, now flows for two and a half miles *across* the structure and almost straight toward the Deep Creek gap. Then with a sharp turn (Fig. 3, A), showing practically all the features of an elbow of capture, it flows off to the west to enter the Susquehanna near Millersburg.

The Schuylkill and the Lehigh Rivers, as in fact practically all the streams of the immediate coal basins, flow in narrow, steep-sided valleys, with numerous gorge-like water gaps where they cross the ridges. The gaps vary only in size from those of the Susquehanna, but add the feature of double gaps, not always opposite each other where the streams cross the closely set double series of ridges. The gaps of the Schuylkill and the Swatara are good examples, where they cross Second and Sharp Mountains. Only in the larger valleys is there any marked development of flood plain in the present cycle. It is most marked along the Susquehanna on the western border of the district. The flood plain near Selinsgrove also shows a well-marked example of more rapid aggradation near the main river. As a result of this action Penn's and Middle Creeks, unable to flow up the slope, turn and flow parallel to the Susquehanna, the former for over four miles, until they are taken in as the river swings over against the valley wall. This case affords a striking small scale analogy to the famous example of the Mississippi and Yazoo Rivers. Shamokin Creek near Sunbury shows a less marked deflection, while Paxton Creek, near Harrisburg, is perhaps even more striking.

The North Branch of the Susquehanna is especially noteworthy since the portion flowing in the Wyoming Valley affords the clearest remaining trace of the consequent drainage developed on the original folded surface. The North Branch enters the Wyoming Valley from the north through a narrow gap opposite Pittston, and flows along the valley as far as Nanticoke. Near the latter place the river turns sharply to the right, entering a narrow gorge, which it occupies as far as Shickshinny, where, in another turn, it breaks out through Penobscot Mountain toward the south. The Wyoming Valley represents the deepest part of an original synclinal trough in which a consequent stream was developed. This part of its course has been maintained through subsequent changes because no more favorable course has been offered. Both up stream and down stream, however, peneplanation, uplift and adjustments to structure have induced the changes from the original course. Along its course in the valley the North Branch follows a broad, flat plain. At first glance it suggests a broad flood plain, similar to the flood plains found both up and down stream, here wider because the river is flowing along the weaker strata of the coal measures. But the straight line character of the bounding slopes, the course of the river over the plain and the nature of the material composing the plain are not characteristic of a normal river-developed flood plain. The plain is due to the filling of an old valley by glacial deposits and will be more fully explained under that head.

Summary.

The anthracite coal region is like the Juniata district a part of the ridge and valley belt of the younger Appalachians. But it differs from the latter in several important respects: (1) The ridges appear in a double set, owing to the presence of a different series of strata containing two resistent ridge makers; (2) in the eastern part of the district much minor close-folding has given an irregular, rugged topography; (3) the valleys have been developed on narrow belts of shales; they are clearly developed only in the western portion, and then less extensively and less perfectly than in the Juniata region, while toward the east all regularity of arrangement is lost; (4) the rivers show the same characteristic of transverse main streams, but lateral subsequents, and the grapevine pattern of drainage are less marked; (5) there was but little development of valley lowland in the Tertiary cycle of erosion, and hence there is but little open country at the present time. These differences arise chiefly from the presence of more prominent ridge-making strata and less prominent, easily eroded valley-making strata, coupled with much more complicated structures than exist in the Juniata region.

PLATEAU PROVIDENCE

Location and Extent.

The plateau province includes within its limits the entire western and northern portions of the State, with an extent greater than the combined areas of the central and southeast provinces. It comprises the whole of thirty-three counties from the extreme southwest to the northwest and northeast corners of the State, making over 25,000 square miles, or nearly two-thirds the area of the State. The plateau, being a part of the great Allegheny plateau, shows but two natural boundaries in this State (Map, Fig. 1). On the north, west and south, the Pennsylvania area is bounded by the state lines of New York, Ohio, West Virginia and Maryland, beyond each of which similar surface forms prevail. But on the northwest, it is limited by Lake Erie, and on the east by the Allegheny Front, or escarpment (Map, Fig. 1), separating it from the central province.

Allegheny Escarpment.

The Allegheny Front, or escarpment, is often called Allegheny Mountain, receiving the latter name because of its mountainous appearance to the early settlers as they approached it from the east. Thus from the top of Bald Eagle or Brush Mountain the Front appears like a great, irregular wall, ranging northeast and southwest, along the base of which project many spurs, separating the short, narrow ravines descending from the knob-surmounted crest. But from the crest of the Front itself a long, gentle slope descends to the west to meet the level of the plateau uplands. It is therefore not a mountain at all, but rather the southeast facing escarpment of the plateau, held up by the massive Pottsville conglomerate above the valley lowlands of the Juniata country.

From above, or from a distance, can also be seen a grand terrace, made by the even tops of the range of projecting spurs, and breaking the eastern slope of the Front. The terrace is nowhere better shown than near Altoona. The valley upland in the region stands at about 1,200 feet, from which there is a moderately steep ascent to a level of 1,600 to 1,700 feet, prevailing over a belt from a mile to a mile and a half wide, making the terrace. From the terrace there is an abrupt rise to the crest of the escarpment at 2,400 to 2,700 feet. When seen near at hand, however, the terrace looks like a broken region of irregular hills—the result of dissection by numerous streams. The terrace is due to the presence of a second resistant formation, and as the crest of the Front becomes lower toward the northeast the terrace is entirely absent.

The Allegheny escarpment crosses the State from the Maryland line in Somerset County, in a sweeping curve toward the northeast for a distance of 230 miles, until it merges obscurely with the anthracite region zigzags in the northeast corner of the State. Throughout this extent the escarpment is broken only by the long, narrow ravines through which flow the northern branches of the Susquehanna, the North Branch, Muncy, Loyalsock, Lycoming and Pine Creeks, the West Branch, and Beech Creek. South from the gorge of Beech Creek, the Front is unbroken by any large stream, though many steep ravines notch its crest and offer the various routes of communication with the region beyond.

From the Maryland line almost to Gallitzin, in Cambria County, a distance of about fifty miles, the crest of the Front is rather broad and flat and nearly straight, at a fairly uniform elevation of between 2,500 and 2,700 feet. Above this level occasional knobs rise to heights of 3,000 or more feet, as Blue

Knob, fifteen miles south of Gallitzin, 3,136 feet, the highest point in the State.

Northward from Cambria County the crest is less straight, gradually decreases in height and consists in places of two crests, each marked by a line of knobs. As the region of transverse streams is approached in Center, Clinton and Lycoming Counties, the Front has been much dissected by the streams and their tributaries. The wall-like character so pronounced toward the south is practically lost, being replaced by a series of irregular hills varying in elevation up to 1,800 feet. Beyond Muncy Creek the escarpment again becomes distinct in Great North Mountain, along the Wyoming-Luzerne County line, stretching off at an elevation of 2,300 to 2,400 feet to within a few miles of the northeast corner of the State.

The larger main streams have cut valleys, narrow and steep-sided, 500 or more feet deep, as well shown by the transverse course of the Youghiogheny. The smaller tributaries flow mainly in shallower valleys, and especially in their upper portions they show a wider valley floor in proportion to their size. The explanation lies chiefly in revival by uplift, so recent that the smaller streams have entrenched only their lower courses. It may also be due partly to the fact that having cut less deeply, the smaller streams are in many cases flowing on the softer strata of the lower coal series, where valley widening is easy, while the larger streams in cutting down deeper have met the harder underlying strata, where valley widening is difficult.

The portion of the region lying between Laurel Hill and the plateau escarpment, with the exception of Negro Mountain, is of essentially the same character as Ligonier Valley—a high upland surface broken by the deep ravines in which the streams flow. Many of the streams, flowing down from the crest of the Front, have found the slope of the surface itself nearly satisfactory, hence in the upper courses they flow in relatively shallow valleys, often not more than 100 feet deep. Along the border of the district therefore there is, especially in northern Somerset and southern Cambria Counties, a less dissected strip a few miles wide, sloping away to the west.

Southwest Division.

The second division of the plateau province comprises the southwest counties of the States lying to the west of Chestnut Ridge and south of the Ohio River. It might properly be called the bituminous coal region, since here the greatest extent of the coal-bearing series is preserved. The surface form may be briefly characterized as that of a maturely dissected plateau. The main valleys are for the most part narrow, ranging from 300 to 500 feet deep. The valley walls are often steep and precipitous with lines of cliffs; or again with gentler, unbroken slopes rising to the upland level. This diversity of surface form results from the presence of broad, flat folds in the strata. In the anticlinal folds the harder strata near the base of the coal measure series closely underlie the upland surface. Hence where a stream crosses an anticlinal fold the presence of the harder rocks causes the valley to narrow into a shallow gorge, analogous to the gorge of the Youghiogheny across the Chestnut Ridge anticline. Where a stream crosses a synclinal fold, on the other hand, the presence of the softer strata favors the development of a wider, more open valley, with gentle ascents to the upland. These varied conditions are shown clearly along the course of Loyalhanna Creek from the gap in Chestnut Ridge to its junction with the Conemaugh. In a distance of about twenty miles, the creek flows through three stretches of open valley, separated by two stretches of narrow ravine. One ravine is northeast of Latrobe, the other, more marked, is south of Saltsburg. The Youghiogheny flows through a similar ravine between Dawson and Layton, in Fayette County.

The open character of the valleys is nowhere better shown than in Washington and northern Greene Counties. There a surface made by softer strata has been sculptured by many small streams into a rolling country with well-opened-out valleys. Most of the valleys are not more than 200 to 300 feet below the upland, as those of Chartier's, Ten Mile, Upper Raccoon and Buffalo Creeks. The same conditions prevail to a large extent northward, almost to the Ohio River, but there changing gradually to a condition of deeper valleys, whose sides are often nearly as bluff as those of the Ohio Valley itself. Still farther north, in Beaver County, harder rocks near the surface have produced many steep slopes and narrow valleys. Thus along a single stream, as the Conoquenessing, the valley is open, with gently sloping sides near the headwaters where the stream has not cut down to the massive sandstone. But farther down stream, where the valley is deep enough to encounter the harder strata, the river flows in a miniature canyon between cliffs 100 feet high.

Though the texture of the strata underlying the surface has exerted a very definite control over the character of the valleys and the hill slopes, it has had hardly any appreciable effect on the height of the upland. Over most of the southwest region the upland level is constant to a marked degree at an elevation from 1,200 to 1,300 feet. An occasional small area, as in Dry Ridge west of Latrobe, or Fort Hill ridge east of Perryopolis, rises 100 feet higher. The extent of the upland level now remaining, however, is relatively small. The surface is composed chiefly of slopes, with but a slight percentage of the area made by level uplands. In the regions of softer rocks, the development of more open valleys has reduced the upland remnant practically to its last degree, as seen in the rounded hilltops of Washington and Greene Counties. Where the harder strata lie near the surface, however, the extent of upland is greater, as is well shown in the flat-topped hills of Beaver County, often a mile or more across.

Rivers of the Southwest Division.

The rivers of the southwest region all flow to the Ohio, either directly or through its main tributaries,—the Youghiogheny, Monongahela, Conemaugh and Allegheny. The river valleys have already been sufficiently described. But the streams show certain other features worthy of notice.

Perhaps the most general feature of all is the prevalence of meandering courses both in large and in small streams. From the meandering habit, in entrenched valleys, it appears that nearly all of the streams were developed on the peneplain surface and have maintained their courses during subsequent uplifts. The only exceptions to this generalization are the few short streams flowing directly into the main streams.

The attitude of the strata and uniformity of conditions over broad areas did not favor the development of lateral subsequents, after uplift, with the attendant rearrangement of drainage, as in the central province. Before uplift many of the streams had acquired regular patterns of meanders, well shown along the Monongahela, Youghiogheny and Conemaugh. The meanders of the Monongahela, though slightly incompetent in places, furnish a perfect illustration of the undercut cliffs and unsymmetrical spur near Marchandville. Many of the smaller streams show irregular patterns of meanders, as Raccoon Creek, in which the irregularities appear to have been developed during entrenchment.

The largest rivers of the region, however, have succeeded in opening out but narrow strips of flood plain, as represented by the scrolls, hardly more than a quarter of a mile wide, along the Monongahela. At the same time numerous smaller streams are flowing over broad valley floors several times the width of the streams themselves, especially in the upper courses. This conditions is shown by Sewickley and Jacob's Creeks, in Westmoreland County, by Ten Mile Creek, in Greene County, and by Raccoon Creek, in Beaver County. In each case the stream has a steeper gradient near the mouth, indicating recent revival, since which these smaller streams have succeeded in entrenching only their lower courses. The broader floors in the upper courses therefore represent the valley bottom of the earlier cycle.

The presence of flat-topped terraces, now more or less dissected, at an elevation of 1,000 to 1,100 feet along the main streams, indicates the existence of a well-marked valley floor before revival occurred. The terrace is distinct at several places along the Youghiogheny, notably at Sewickley, New Haven and Port Royal; and along the Monongahela near Rice's Landing and New Geneva. But the best example is along the Conemaugh, especially in the region to the west of Blairsville, where, for several miles, broad, flat terraces border the river on either side. The tops of the terraces are strikingly uniform at an elevation of 1,000 feet, about 100 feet above the present river level and 200 feet below the surrounding upland. In its form, in the outline of its bounding slopes, and in the river laid character of the clays and gravels covering the surface, this intermediate level has the essential features of a broad valley floor opened out by a meandering river.

Associated with the terrace level are found instances of apparently abandoned river channels, resembling cut-off river meanders, in that the curved course encloses an isolated spur. The best examples are near Bellevernon, Perryopolis and Carmichael. The Bellevernon case shows two isolated spur hills rising to heights of 1,220 and 1,180 feet respectively, with the abandoned channels at an elevation of about 980 feet, 200 feet above the present river level. In each case the arc of the curve shows that they are not normally developed cut-off meanders, for the river ends of the old channel at Bellevernon are a mile apart and in the Carmichael example they are nearly four miles apart. The most satisfactory theory of the origin of the abandoned channels, which occur in West Virginia and Ohio as well, has been offered by Campbell.[1] It explains them through the breaking up of river ice, while the region was still under the influence of the glacial epoch. Ice dams are supposed to have been found of sufficient height to force the ponded stream to seek an outlet over the lowest divide in the rim of the basin, and of sufficient duration for the streams to firmly establish themselves in the new position. It is not unreasonable to suppose, however, that there should be some places where the ice dam was not permanent long enough to allow complete abandonment of the old course; partially developed cross-cuts should be found. But as yet there is no record of such features having been observed.

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[1] Campbell, M. R.: Hypothesis to Account for the Extra-glacial Abandoned Valleys of the Ohio Basin. Bull. Geol. Soc. Am., Vol. XII, pp. 462-463 (abstract).

Northern and Central Area.

This largest division of the plateau province, the central and northern district, includes all the area between the Allegheny River on the west, the plateau escarpment on the east, Conemaugh River on the south and the State line on the north. But between this region and the southwest district there is no sharp line of division. The conditions found south and southwest of the Conemaugh merge gradually northward into the closely analogous conditions which are characteristic of the region to the north.

Throughout this great extent local conditions of altitude, amount of relief nature of the valleys and uplands, vary much. But the general character of the surface is the same—that of a broad, gently-sloping table-land, everywhere broken by ramified streams into an endless variety of detached hills. In the southwestern part of the area the general elevation from 1,200 to 1,400 feet. Toward the north and northeast the upland surface rises slowly, reaching an elevation of about 1,800 to 2,000 feet in the region of Clearfield County, and from 2,400 to 2,500 feet in Tioga and Potter Counties. This high altitude, however, prevails over only a relatively small area, for in most of its extent along the northern border of the State the upland ranges from 1,800 to 2,200 feet above sea level.

Wherever the surface is underlain by the same set of strata, it is cut into hills and valleys of the same general style. One valley cannot be called the counterpart of another, nor are the hills and uplands always alike, yet the type of topography is the same. A view from the top of any well exposed upland gives a good idea of what the country is like. Below the upland lies a valley as variable in the nature of its slopes as it is irregular in its course. Here steep walls rise from the stream on both sides. There a sharp descent on one side is faced by a long, gentle slope on the other. Numerous ravines, some short, some long, some deep, some shallow, are occupied by the smaller streams which flow in from either side. As far as the eye can see in all directions the uplands stretch away in a broad, undulating tableland, unbroken by ridges, but on every hand bearing the deep scars of a multitude of valleys and ravines.

In the western part, along the Allegheny River, the many tributaries have deeply dissected the upland surface, producing a very rugged type of topography. A good example of this condition is found in Clarion County where Clarion River and Red Bank and Mahoning Creeks have cut deep, steep-sided valleys. Much the same sort of condition prevails along the West Branch and its chief tributary, Sinnemahoning Creek. But in neither of these regions is the relief much over 500 to 600 feet. In Tioga and Potter Counties, on the other hand, much of the upland, held up by the Pocono sandstone, still keeps an altitude of about 2,500 feet. Where this region has been trenched by the streams is found the most rugged surface in the State, with steep-sided, narrow, ravine valleys, 800 to 1,000 feet deep. Bowman's and Mehoopany Creeks, as they flow through the high upland of Great North Mountain in Wyoming County, occupy similar narrow valleys of about the same depth.

Rivers of the Central and Northern Division.

The drainage of the central and northern district belongs in part to each of three great systems. The western and northwestern streams, the Allegheny and its tributaries, belong to the Ohio system. The eastern and northeastern portions drain to the Susquehanna through the West Branch and the North Branch and their tributaries. And a small area in northern Potter County is drained by the headwaters of the Genesee, a tributary of the St. Lawrence system. Between the different systems, however, the divides are extremely irregular, often being marked only by the flat top of an intervening hill. For example, according to an entry in Hazard's Register (p. 173), the water from a ditch dug on the summit level of one upland was said to run from one end to the Allegheny and from the other to the Susquehanna.

All the streams of the region flow in entrenched valleys from 200 to 1,000 feet deep. Though there is a rather less marked development of meanders along many of the smaller streams, most of the courses appear to have been acquired previous to uplift. Entrenched meanders are shown along all the main streams. The Allegheny and its tributaries, Clarion River, and Red Bank and Mahoning Creeks, the West Branch and the North Branch of the Susquehanna, show many typical instances of regular sweeping curves, with unsymmetrical side slopes in the valley walls. Along with the meanders there are beginning to appear scrolls of flood plain, similar to the conditions along the Monongahela.

The relatively broader valley floors along some of the smaller streams, as in the case of Cowanshannock Creek, near Rural Valley, or of Crooked Creek, near the the Armstrong-Indiana County line, present a close analogy to the smaller streams of the southwest district. Crooked Creek also shows flat-topped terraces at an elevation of 1,000 feet, similar to the terraces along the Loyalhanna. But along the main streams the absence of high level terraces, often for many miles, is in sharp contrast with the conditions along the Conemaugh or Youghiogheny. Abandoned channels, however, analogous in character, and probably in origin, to the Bellevernon and Perryopolis examples, appear near Parker on the Allegheny and at Callensburg, about six miles to the northeast, on the Clarion River.

Northwest District.

The northwest division of the plateau lies between the Allegheny River and the Ohio State line. It is practically coincident with the glaciated area in the northwest corner of the State. In the southern part and along the eastern border of the district the general elevation of the upland is about 1,200 to 1,400 feet, slightly lower in the southwest, somewhat higher in the northeast. Toward the west the upland gradually descends to a level of 900 to 1,000 feet along the Ohio line, from which, in northern Erie County, there is a steep descent of 200 feet to the Erie lowland.

Though the northwest region, like the rest of the plateau, shows over much of its extent a surface broken into flat-topped hills by numerous stream valleys, the amount of dissection and surface relief is distinctly less than in any other district. Along the eastern border the short tributaries of the Allegheny have given a type of topography analogous to that of the central area; and along the southern border the surface is not unlike parts of the southwest region. But from these borders the transition is relatively rapid, both west and north, to a condition of shallower valleys, more gentle slopes and broader upland areas. This contrast in surface form is due to two factors: first, the area is underlain by hard, flat-lying strata of sandstone and conglomerate, favoring broader uplands by their resistance to erosion; and second, to the presence of a thick coating of glacial drift which, by filling valleys and blanketing hill-slopes, has smoothed out many of the inequalities.

The Erie area, with its forty miles of lake front, is the only part of the State in which shore phenomena are illustrated —here including wave-cut cliffs, stream deltas and along-shore current action in building sand bars. The Erie shore along most of its extent in this State is faced by a steep wave-cut cliff of sand and clay, 50 to 100 feet high, at the base of which lies a narrow wave-made beach. The nearly straight cliff face is broken only by the short gullies of the streams which flow down its front and by the deeper, wider valleys of the larger rivers descending from the upland. Here and there the narrow beach is slightly built forward where the streams mouth, indicating the development of deltas, kept from very extended growth by the wave and current action on the exposed shore.

The effect of along-shore currents is best illustrated in the great flying spit known as Presque Isle (Fig. 4), making the harbor for Erie city. Beginning about three miles west of the city limits, the spit appears first as a low, sandy bar, hardly more than 100 yards wide where it is attached to the mainland. From there it quickly swings out from the shore toward the northeast for a distance of six miles, not perfectly straight, however, but soon looping round toward the mainland. The width in the first three miles of its extent is nowhere much over a quarter of a mile; but then it widens rapidly to over a mile opposite Presque Isle light. The outer shore presents the characteristic clean-cut, sweeping outline of the wave and current-made beach, in sharp contrast with the, also typical, irregular edge fronting the quiet water within the harbor (Fig. 4).

The surface of the spit, though nowhere much over twenty feet above the lake level, shows lines of sand dunes, separate and in ridges, alternating with lower marshes and enclosed ponds. These lines of sand ridges, roughly parallel with each other and with the present eastern front of the spit, represent successive stages in the forward growth. That this growth has been toward the east as the result of a west to east 'long-shore movement is shown by (1) the connection with the mainland at the western end; (2) the long, smooth, unbroken sweep out from the shore, in distinct contrast with the shorter, less regular and broken curve toward the mainland on the east; (3) the increase in size and length of the parallel sand ridges toward the east; and (4) the crowding of river mouths toward the east sides of their valleys, by the growth of small bars from the west, as is clearly shown at the mouth of Elk Creek in Girard

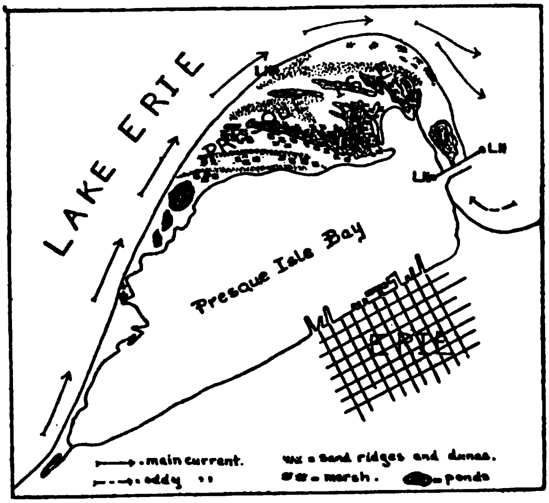

FIG. 4.

Presque Isle and vicinity, illustrating 'longshore action.

Township and by numerous other creeks along the Ohio and New York shores.

The outer border of the spit, near the lighthouse, reaches a maximum distance of about two and a half miles from the mainland, but its eastern end is less than a mile away, with a small V-shaped cusp jutting out to meet it. This cusp is apparently due to the action of a back-set eddy (Fig. 4) from the main current from west to east, associated with which there was undoubtedly some current action on the bay side of the cusp. The tendency of the two sets of currents is to build forward both spit and cusp until they meet, thereby completely enclosing Erie harbor. This result has been prevented only by the building of long jetties from both sides to change the sweep of the currents and preserve the narrow entrance to the quiet waters within.

Pocono Region.

The Pocono plateau lies in the northeast corner of the State, almost completely separated from the rest of the plateau by the deep synclinal trough making the Wyoming Valley. The Pocono plateau, covering Monroe, Pike, Wayne and eastern Carbon Counties, merges southwestward into the ridge area of the anthracite coal region, and extends east and north to become the Catskill plateau of New York State. Nearly all of the area is underlain by the hard sandstone and conglomerate strata at the bottom of the coal measure series, here spread out in broad, nearly horizontal, outcrops.

The southern edge of the plateau, often known as Pocono Mountain, presents a close analogy to the Allegheny escarpment, both in origin and character. It is an erosional escarpment, 1,000 feet high, with a step-like ascent resulting from the horizontal position of the strata. The alternation of sandstone and shale in the escarpment, especially south of Dingman's Ferry, shows this step character very distinctly.

The plateau back of the boundary escarpment is a nearly level upland wilderness, known to the early settlers as the "Great Beech Woods" and the "Shades of Death." The plateau over most of its extent has a general elevation of 1,400 to 1,800 feet. Below this level the streams have cut valleys 100 to 200 feet deep, and an occasional knob rises 200 or more feet above the upland. Though often described as one of the wildest parts of the State, "a wilderness of forest and swamp," it is made picturesque by the numerous lakes and cascading streams resulting from the glacial action to which the region has been subjected.

Summary.

The plateau province possesses almost the same series of strata as is found in the anthracite coal region. But the topography is sharply contrasted in the two areas because of the differences in structure—nearly horizontal in the former, closely folded in the latter. In the central province the structural control resulted in the development of the characteristic grapevine pattern of adjusted subsequent drainage. In the plateau province the absence of structural control resulted in the development of a ramified, dendritic pattern of *insequent* drainage. Over the entire area the streams branch again and again, until there is hardly a square mile into which one or more has not worked its way. In the central province the hard strata stand up as sharp ridges. In the plateau province the same hard strata give only somewhat broader interstream uplands and narrower, steeper-sided valleys. The only important point of similarity between the two regions is in the presence of the three anticlinal ridges, Negro Mountain, Laurel Hill and Chestnut Ridge. Over the rest of the western province the surface is that of a well-dissected plateau, varying from place to place, both in elevation and in surface detail, yet everywhere preserving the general feature of more or less rugged relief produced by the trenching valleys of innumerable streams.

The Industrial Situation in the South: A Study in Economic Geography.

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There is ample justification for speaking of a southern labor problem as distinctive from the general labor situation throughout the United States. The same general conditions regulate supply and demand, and consequently the scale of wages, in all the States. But the industrial development of the Southern States, having sprung from widely different social and physical conditions, has progressed along lines so distinctive as to give rise to a well-defined individualism in the labor situation. The differentiation is not so marked now as it was under the slavery regime, but that system which shaped the industrial, social and political policies of a people for more than four generations could lose neither its power nor significance in a day.

A change of labor may be as characteristic in industrial evolution as a change of laborers, but the South has experienced both in an important sense. The situation remained comparatively simple as long as there was a large surplus of land and a small surplus of capital, but as the supply of land has decreased and capital has increased, the complications have become more intricate. It is only within recent years that this change has taken place in the South to the point of inaugurating a new industrial era,—a period of diversified production both as to raw and manufactured products. The native labor supply, being for the most part unskilled, makes it necessary that the demand be met by training the laborers, and by the importation of skilled workmen from without. This is therefore a critical period of adjustment by training, selection, and elimination. Since the establishing stage is usually the most burdensome, it does not seem unreasonable to predict that the labor problem of the future South will offer no more serious difficulties than those of the present.

The total population of the Southern States (1900) was 24,523,527, 69 per cent. being native whites, 32.3 per cent. (7,922,969) of negro descent, and 2.3 per cent. (562,575) foreign. The total population increased 1890-1900 24.4 per cent.; the rural population 18.3 per cent.; cities of 4,000 inhabitants and over increased 38.4 per cent.; and incorporated towns of less than 4,000 inhabitants increased 52.8 per cent. The figures indicate the marked tendency toward concentration in cities and towns. Not only is there a large migration to the cities and towns, but also to the less densely populated regions of the West and Northwest, where land is cheaper and farm wages somewhat higher.

AGRICULTURE.

This continues to be by far the most important source of revenue in the South. More than 4,500,000 males are engaged in this occupation, or 18 per cent. of the total population. The changes which are being made in the methods of management and cultivation are almost as marked as those in other lines of industrial development. The combined economic forces have contrived to usher in an era of intensive and diversified production. This has the effect of increasing the demand for the best class of laborers. Probably at no time in the history of the country has efficient farm labor been so difficult to obtain, and at no time have farm wages been so high, except in the period of an enormously inflated cotton market following the Civil War.

Cotton is now the only important export crop. To supply adequate labor for an increased production is the most serious problem in connection with southern agriculture. The climatic and physical conditions are such as to make the southern part of the United States the only great cotton field of the world, so that to meet the demand is imperative from the standpoint of the prosperity of the region, and of the world's need. At the last census 24,275,500 acres were in cultivation, yielding 9,534,707 bales. Of this, 94 per cent. was produced in Texas, Mississippi, Georgia, Alabama, South Carolina, Arkansas, Louisiana and North Carolina. It is estimated that there are at least 50,000,000 acres of land in this cotton belt adapted to the successful culture of cotton. The pressing demand for the product is sure to come with the increase of the world's population.

The labor supply is inadequate for the present acreage. The question arises, how shall the increased demand be met. The negro is the only laborer who has yet demonstrated an aptitude for the climatic conditions existing over large areas of the cotton belt. Statistics show, however, that they are gradually leaving the farms and plantations, and that the service of many who remain is becoming more irregular with each year. The unusual prosperity of the country, causing a rapid development of the resources and the increased demand for domestic servants in the growing cities and towns foster this spirit of unreliability. The same causes, together with the phenomenal growth of cotton mills in the South, creates a similar demand for the native white laborers. The situation is more acute in some sections than others, but the industrial development is so extensive and so widely distributed as to bring all sections under its dominant influence.

Farm wages are twenty to sixty per cent. higher than ten years ago, the increase having been greatest in those States that have developed the mining and factory interests most rapidly. The wages of domestic servants has increased in about the same degree. Experienced farm hands easily command $1 per day without board, or $20 per month with board. Many farmers report an inability to secure good laborers at this figure. To bring about a more favorable adjustment, the large plantations are being divided into small farms. The number of farms increased in the South more than forty per cent. during the past decade. This enables many small owners, who would not hire as day laborers, to rent small farms on the cash basis.

The better class of laborers also share in the prosperity of good wages and through economy and good management become able to pay cash rental, eventually purchasing small holdings. The desire to cease being competitors with negro labor is a powerful stimulus in this direction. It may also be said that the better class of negro laborers are passing through the same evolution in their desire to avoid competition with that class of laborers known as the "poor whites." All of this greatly increases production by improving the service of the producers.

This development cannot be expected to progress to the extent of meeting the demand fully, however favorable it might be to the country. Even the present phase is not without its difficulties. The small owner needs hired labor only during the busiest season, when the labor surplus is least. The safest solution suggested is that the owners either plan their operations with reference to a self-performance, or so diversify their productions as to justify hiring one or more laborers by the year. The labor demand can be much decreased by the more extensive introduction of stock-raising and dairying in regions adapted to grass and other forage crops.

Further improvements will be made in machinery and its more extended use will contribute to the reduction of the labor demand. A successful cotton picking machine would do more in this particular than any other machine could, being to the present situation what the cotton gin was to the time of its invention. A corn harvester adapted to the uplands is also yet to be perfected. A large supply of the most efficient labor has been lost to the South by the westward migration. As home cultivation becomes more profitable and the price of western lands higher, this stream will dwindle, and the laborers will be left to help solve the problems of the South.

It cannot be argued that the general standard of service has deteriorated. Much of it has so advanced as to leave the poorer grade of workmen strikingly deficient. It is certainly true that the standard of requirement has been raised more rapidly than the standard of service. But it should be remembered that the many sources of instruction open to the intelligent farmer through the technical schools, the various government bureaus and the agricultural literature have given him an opportunity for advancement which the common laborer has not had.

Scientific agriculture not only teaches how to make two blades grow where only one grew before, but it teaches the producer how to cultivate two acres with less energy than was formerly spent on one, and how with that energy to effect a better cultivation. Herein lies the most hopeful factor in the solution of the labor problem of the South.

MANUFACTURES.

The centers for different industries shift with the development of the country. In the days of slavery the South was a heavy producer of home-manufactures, but with the abolition of slaves came the great financial crash which made impossible the early development of factory interests. The southern people were not blind to the losses entailed in shipping out their raw products and buying back the same in the form of manufactured articles. Hence experiments in manufacture began when the supply of capital permitted. These undertakings proved so profitable that northern manufacturers were swift to protect themselves by the establishment of southern factories. Both southern and northern capital are now active in the establishment of new enterprises.

From 1890-1900 the total number of factory wage-earners in the South increased thirty-seven per cent., and the proportionate increase since 1900 has been much greater.

The average annual wage of factory laborers increased 1880-1900 as follows: Southern States from $237 to $300, or 26 per cent.; Middle States from $356 to $461, or 30 per cent.; Central States from $353 to $446, or 26 per cent.; and New England States from $346 to $437, or 26 per cent.

The industries showing the most rapid development are in order: cotton goods, lumber products, tobacco, iron and steel, and fertilizer.

Cotton Goods.—The manufacture of cotton goods is the most rapidly developing industry in the South. It is concentrated along the Piedmont region from southern Virginia to central Alabama, being greatest in North and South Carolina. In 1900, 98,000 wage-earners were employed, and reliable authorities state that the number and the output have been more than doubled since that date. During the decade 1890-1900 the value increased 128.8 per cent. In 1890, there were only 36,415 employed in the cotton mills, from which it appears that there has been an increase of about 500 per cent. in fifteen years. Of the total increase of cotton products in the United States for the past decade, 75.1 per cent. was shown by the Southern States. It is safe to say therefore that the centre of this industry has already shifted from New England to the Southern States. All the conditions favor as rapid growth in the future, because the southern mills are near the supply of raw material and easily utilized water power; the climate is mild and healthful, living expenses are reasonable, and labor is somewhat cheaper.

How the labor demand in the cotton factories shall be met is an important problem. The supply is now small, and provision must be made not only for the increased demand, but also for the practical elimination of the labor of children, who now constitute 25.1 per cent. of the total wage-earners. There was a marked decrease from 1880 to 1900 in the percentage of children employed throughout the United States, with the exception of the Southern States.

Better wages and the opportunity of securing employment for the whole family have enabled the factories to draw a larger labor supply from the country, but the payment of higher wages on the farm and the strong competition in other lines make this source entirely inadequate even for the present demand. The negro has thus far proven unsatisfactory as a factory laborer. He shows an inaptitude for acquiring the necessary skill, and is unwilling to work with that regularity required of cotton mill employees.

With the exhaustion of the native white surplus and the growth of the industry, higher wages will have to be offered and a larger foreign contingency imported. This, together with the shifting of the industry from New England to the

South, will gradually bring about a new distribution of laborers trained in the work by long service.

Lumber Products.—This industry in 1900 gave employment to 118,491 persons, or one-sixth of the total number engaged in manufactures, and there has been an increase of about 25 per cent. since that date. The States employing more than 10,000 men were as follows: Georgia, Arkansas, Mississippi, Tennessee, Florida and Louisiana. Forest hands and unskilled mill hands receive $1.00 to $1.75 per day. Furniture factories are being established in large nubers. These require skilled workmen, who command a wage of $1.25 to $4.00 per day.

The timber regions are being so rapidly deforested that the demand for unskilled laborers will probably not be greater than it is at present, but the demand for skilled workmen in the factories will greatly increase. The lumber camps are usually made up of a rough class of laborers, as a result of the meager comforts and the uninviting social environment. Thousands of small mills are scattered through the States, and become strong competitors for the surplus labor which formerly found irregular employment on the farms.

Tobacco.—The tobacco industry is very important in the South, giving employment to 40,000 wage-earners. The manufacture of plug tobacco is almost all limited to the Southern States. Kentucky leads both in production and manufacture, followed by North Carolina, Virginia and Florida. The percentage of children (under sixteen years of age) employed is as follows: Kentucky, 13 per cent.; North Carolina, 23 per cent.; Virginia, 13 per cent., and Florida, 0.1 per cent. The percentage of women employed in the industry varies from 10 to 50 per cent.

Most of the tobacco factories are located in the larger cities, and are thereby not brought into strong competition with the textile industry. Since comparatively little skill is required for most of the work of tobacco factories, it is not difficult to supply the demand.

In 1880, the value of the products of tobacco manufactured in the South was $25,938,212; in 1900, it was $78,091,650. an increase of 201.1 per cent. This was 31.7 per cent. of the total increase in the United States. Notwithstanding the enormous production, the consumption is increasing so rapidly that profitable prices are steadily maintained for the raw product.

COAL AND IRON MINING. STEEL INDUSTRIES.

Coal.—This was the first mineral resource of the South to be developed, and has been developed more rapidly and more extensively than any other. There are three well-defined coal fields, which may be designated as the Virginia-West Virginia, the Alabama and the Arkansas.

In 1900, 70,412 laborers were engaged in coal mining; in 1904, 103,749 were thus engaged, an increase of 47 per cent. The total value of the product was $39,612,006 in 1900, and $59,340,622 in 1904, an increase of 49 per cent.

The ten-hour system prevails in almost all of the southern mines. The largest increase in the number of laborers employed was shown by Arkansas—63 per cent. About 30,000 laborers are employed in the Pocahontas Flat Top field (Virginia-West Virginia), in which the laborers are approximately distributed as follows: White Americans, 40 per cent.; negroes, 30 per cent., and foreigners, 30 per cent. The foreigners are chiefly Hungarians, Italians, Poles and Slavs. Coal operators find it difficult to employ the best class of white laborers, because the average living accommodations are not good enough to induce that class to stay in the field, and because of the objection of the whites to working with negroes or foreigners. Most of the mining communities are practically without religious or educational advantages.

The Hungarians and Italians are generally considered to be the best miners, but the majority of the foreigners are migratory in their habits, moving from place to place as circumstances or their peculiar fancy may dictate. The conditions seem to suit the negro, since he is content to live in a rented house and consume his wages as fast as earned,—especially if it is done by resting two or three days in the week. The wages are based upon tonnage, and the regularity of the work governed by the supply of cars. This results in a well-paid but irregular service. A good miner working ten hours per day can make $75 to $125 per month, depending on the height (thickness) of the coal, but an average of fifteen to twenty days' work per month is the best that can be expected.

Labor unions have not made great progress in the South. They will be strongest when a larger percentage of the workmen own their homes, and when the population is not made up of so many different classes and nationalities. They are much stronger in the Alabama field than in the West Virginia and Arkansas fields.

The general labor situation in mining districts can be much improved by erecting more comfortable houses, supplying better school and church advantages, changing the commissary system, shortening the labor day, and by giving the laborers a reasonable share in the normal advance of prices. There is also an urgent need of an improved transportation service, and a general regulation of the output.

Iron and Steel.—There has been much fluctuation in the iron industry during the past few years, especially prior to 1903. The southern output of ore in 1904 was 5,144,065 tons.

Alabama, Virginia, West Virginia, Tennessee and Georgia are the important iron-producing States. The iron resources are believed to be almost inexhaustible. They have not been worked extensively, however, because most of the ores contain a percentage of phosphorus which makes them unfit for Bessemer steel. They are consequently converted into basic and Bessemer pig iron. The growing demand for iron and the rapid consumption of the better grades secured from the Pennsylvania and Great Lakes fields will bring the southern field increasingly into demand.

The wages of ore handlers vary from $1.25 to $2 per day. There are so many different grades of work in furnace operations that it is difficult to arrive at a general average, since the wages vary from 75 cents per day for helpers to $4 per day for furnace blowers.

LABOR CONDITIONS IN VARIOUS EMPLOYMENTS.

Railroad Construction.—At present railroad construction is one of the strongest competing factors for both skilled and unskilled laborers, and the work of several roads in process of construction is being seriously retarded for lack of laborers. The unskilled laborers on railroad construction constitute a more heterogeneous aggregate than can be found in any other branch of industrial operations. In the same camp will be found Poles, Hungarians, Italians, Irish, Germans, Swedes, negroes and all classes of native whites from the poorest mountain type to the respectable farmer, who finds it more profitable to work his teams at grading than to use them in the cultivation of a crop.

So great is the demand that the contractors send out agents to gather up laborers and deliver them at certain points. These agents are paid so much for each laborer employed, and the result is that all kinds of misrepresentations are made as to the conditions and nature of the employment. While supplying the labor demand theoretically, it produces an inferior service, incurs frequent desertions and disseminates a general spirit of discontent. The sub-contractors in their desire to realize large profits often impose conditions which are not only irksome but intolerable.

The larger per cent of the unskilled laborers are foreigners, who are very susceptible to disappointment. An experienced railroad contractor described the situation as to foreign labor in this way: "The most of the foreign laborers contracted on public works are like a flock of wild geese alighting upon a lowland. If things do not look or go just to suit them, they simply rise and fly to another spot." The general opinion seems to prevail that negroes and Italians are, as a rule, the most satisfactory unskilled laborers in railroad construction.

The standard wage now offered in Virginia, West Virginia, North Carolina and Tennessee is $1.50 per day. The scale runs slightly lower in the extreme Southern States. The average wage is 15 to 25 per cent. higher than it was ten years ago, but the increase in wage is probably not greater than the proportionate increase in the cost of living.

Public Road Construction and Repair.—The rapid industrial development of the South is bound to bring about great improvements in the public roads. The difficulty of securing laborers is being offered in some sections as an excuse for the poor road service. The difficulty arises in many cases from an unwillingness to depart from the old standard of wages. Ten years ago road hands could be obtained more easily at 75 cents per day than now at $1 per day. The situation is often compromised by the employment of boys and inferior workmen, who perform a service so inferior as to be little less than a loss of funds.

There seems to be no serious objection to the leasing of State prisoners for the making and maintenance of public roads, provided they are leased directly to the county, and not to subcontractors.

Child Labor.—The regulation of this class of labor is one of the most serious problems connected with the situation in the South. The percentage of women and children employed in tobacco factories has always been large, and there has been urgent need of an enforced age limit in the mining industry. The most alarming condition, however, exists in the cotton mill districts. In 1900, 24,459 children under sixteen years of age were reported as employed in cotton factories, and there are conclusive reasons for believing that the number was much greater. According to the above figures there was, from 1890 to 1900, an increase of 177 per cent. in the number of children employed. Since 1900 the number employed has been more than doubled.

The causes that have made possible and stimulated child labor are as follows: the negro proved unsatisfactory as a factory laborer, and there is a comparatively small floating foreign population in the South, hence the employers had to depend upon native white laborers to meet the rapidly increasing demand. These came from the plantations and the mountains, where the women and children had been accustomed to working in the house or field. The families were large, as a rule, and the opportunity afforded by the factories for securing employment for the whole family appealed to them as a very desirable and judicious change. They were not in a position to see the evils which would accrue, and some would not have been materially influenced had they realized the disastrous results. The burden of responsibility is not only upon the employees as a class, but also upon the States and those employed to safeguard the interests of her citizens. That the States have been derelict in the performance of their duty is a fact that needs no argument.

The statutes regulating child labor are few and inadequate, and those in existence are rarely enforced. Florida and Mississippi have no laws regulating or pertaining to the employment of children. The only Southern States that place any limit on the number of hours of labor for children are Alabama, Arkansas, Georgia, Louisiana, North Carolina and Virginia. Alabama and Arkansas have the absurd age limit of ten years for factory labor. The age limit for working in the mines of Alabama, North Carolina, South Carolina, Virginia and West Virginia is twelve years.

Foreign Labor.—The sentiment in the South for and against foreign immigration is about equally divided, there being but little if any objection to industrious immigrants of a socially and political assimilable race, and very pronounced and general objection to the low-grade immigrants of non-assimilable races.

That there is a strong demand for foreign labor is shown by the recent bills before several of the State Legislatures. These bills provide for authorized immigrant agents to be sent out by the several States to induce desirable foreigners to locate in the South. Only 2.3 per cent. of the population is foreign born, but as the industrial development progresses the percentage will increase.

The acuteness of the labor situation in the cotton belt has suggested the importation of certain types of Chinese, Koreans and Japanese, who, it is believed, could be readily acclimated, and hired at a comparatively low wage. This, it is claimed, would cheapen and increase the cotton and rice production, and supply conditions for the profitable development of the silk industry in the Southwest. The advisability of this innovation must be determined by future industrial developments.

The Negro as a Laborer.—Of the total population of the South, 32.3 per cent. are negroes or of negro descent. It is impossible to give their distribution among the different classes of labor, since this varies so much from year to year, and even from month to month. In 1900, 28.5 per cent. of the farms of the South were operated by negroes. In Alabama, Arkansas, Georgia, Louisiana, Mississippi, South Carolina and Texas, of the 1,467,423 farms under cultivation, 560,169 are operated by negroes, and 19.1 per cent. of the number operated are owned by them. Notwithstanding the fact that as a race the negroes have shown themselves better adapted to the conditions of the agricultural pursuits and the agricultural regions of the South, there is a growing fever among them for the cities and towns, and there they are congregated with irregular employment, high rents and little or no profits. In these centres are found the hotbeds of vice and crime.

To make the negro a more efficient farm laborer, and to change the tide of his inclinations back to the farm is an important question for the southern farmer, and for the negro himself. His labor is much needed, and must be utilized or supplanted with foreign labor. The most effective remedy will come from a dual move, the one on the part of the white employer, and the other on the part of the negro as the employee. The employer must be willing to provide comfortable houses for his laborers, improve their school advantages, charge only the market price for provisions supplied, encourage economy and the acquirement of property and deal justly and humanely with them. There unfortunately exists in some of the poorer sections race prejudice against the prosperous negro. Where and as long as this exists there can be no satisfactory adjustment, since it can work only to the detriment of both whites and blacks.

First of all, the moral standard of the negro must be raised so as to make him regard promises and contracts as binding; he must be disciplined in the performance of regular work;

and be made to recognize that the brightest industrial prospects for the mass of his race lie in the cultivation of the soil.

There is a growing antipathy among the colored women toward domestic service. The demand for such service is pressing and remunerative, and there is a large surplus of laborers adapted to the work whose earnings are needed for the safest and the most rapid economic progress. The same applies to white laborers who are in similar financial circumstances. The owner will naturally give preference to the tenant or laborer whose family is willing to supply the necessary domestic service. To meet this combined need there is a strong agitation in certain parts of the South for the importation of foreigners who will be willing to supply it.

The negro has been an essential factor in the economic development of the South, but the South has also been a very essential factor in his development. He has the opportunity to profit by all that has gone before, but he also stands the chance of losing ground. Certainly he cannot expect to even hold his place without the willingness to give at least a fairly satisfactory service. The ground lost will not be easily regained, for there are millions whose environment has been such as to make them appreciate the comforts which come from a well-paid service. The negro laborers of South Africa are now being rapidly displaced by Chinese laborers on the same complaints which are being raised in the South.

The question may be asked, Why has the negro the best chance in the South? He has been acclimated at a great cost of life; trained in the thought and customs of the southern people under conditions which inspired a mutual understanding and sympathy between them, such as they can find nowhere else; and there is an urgent demand for the kinds of labor to which he is best adapted.

Nathaniel Southgate Shaler

OBITUARY.

Nathaniel Southgate Shaler, Professor of Geology in Harvard University, an eminent teacher and scholar, died in Cambridge, Mass., on April 10th, after a life of three-score and five years of singular activity and usefulness.

Professor Shaler was born in Newport, Ky., February 20, 1841, and was graduated from the Lawrence Scientific School of Harvard University in 1862. As captain of a Kentucky volunteer battery he served on the Union side for two years of the Civil War, when he returned to Harvard, first as assistant and then as instructor, in paleontology in the Scientific School. In 1869 Shaler was made Professor of Paleontology, from which he was transferred to the Chair of Geology in 1888. This latter position he held up to his death; and in addition to that he served as Dean of the Lawrence Scientific School from 1891 onward.

Professor Shaler's work as a geologist, however, was not confined to the academic side alone. From 1873-1880 he was in charge of the Kentucky Geological Survey, the results of his work being embodied in the "Kentucky Geological Reports and Memoirs," published from 1876 to 1882. After 1884 he was connected with the United States Geological Survey until within a short time of his death; and was sometime director of the Atlantic division of the survey. Among his more important government reports are: "The Geology of Nantucket," and "The Geology of the Narragansett Basin." He was Commissioner of Agriculture for Massachusetts at various times, and was a member of the State Highway Commission. In 1895 he was president of the Geological Society of America.

Aside from the reports connected with his professional work as state and government geologist, Shaler was a prolific writer both in geology and in other fields. Among his best-known books on geological subjects are: First Book in Geology (1885); Story of Our Continent (1892); Sea and Land (1894); Aspects of the Earth (1896); Outlines of the Earth's History (1898). In the field of general science he wrote: The Interpretation of Nature (1893); Domesticated Animals (1895); Man and the Earth (1905). As a historian Shaler appears in: Kentucky (1885. American Commonwealth Series); The United States of America (1894); American Highways (1896). And in social philosophy he wrote: The Individual: A Study of Life and Death (1900); The Citizen: A Study of the Individual and the Government (1904); and, The Neighbor: the Natural History of Human Contacts (1904).

Though he will be remembered by most as one of the greatest of pioneer geologists in America, Professor Shaler was admired by all for his breadth of mind and mental power; for the many fields of learning in which he took a vital interest and an active part. The range of subjects of his published works only partially suggest this trait. Among his earlier books Shaler had invaded the field of history, of economics and of politics. In the later years of his life he was the social and moral philosopher. He was an astronomer for recreation, spending many hours in the study of the moon and in preparing an exhaustive report on his studies. He wrote poetry to prove that he could, and demonstrated his literary ability by writing an Elizabethan drama. His interests were widespread, and whatever he did was typically his own.

As a scholar, Shaler ranks among the foremost that this country has known, uniting in his one master mind a grasp of subjects and a range of interests strikingly diverse in their scope.

As a teacher, Shaler was admired by all who came under his influence. No one could work under him without feeling the effects of his personality. No one could work under him without feeling broader and more human in his interests and a greater enthusiasm for his work. No one who worked under him can help feeling that his death is a personal loss: the loss of an ideal teacher, who guided and encouraged and led, who inspired to active labor in the lines he loved so well.

As a man, Shaler was eminently human. Vigorous, virile, active, almost to the time of his death. Alert in mind and body; quick to grasp, clear of vision, he was ready in thought and straightforward in speech. Powerful and aggressive in argument, prolific in original ideas, generous and fair-minded in judgment, such was Shaler the man.

Nathaniel Southgate Shaler, scholar, teacher, master of men, stood in the ranks of the leaders. In life active, useful, and loved by all who came to know him. In death, remembered by all for the fruits of his life's labors; leaving the world richer for the life he had lived in it; missed and mourned by all because of the loss to the nation.

Israel Cook Russell

OBITUARY.

Israel Cook Russell, Professor of Geology in the University of Michigan, died on May 1st, after a short illness, at his home in Ann Arbor.

Professor Russell was born near Garrattsville, N. Y., December 10, 1852. He was educated at New York University, where he was graduated in 1872, and at the School of Mines, Columbia University, for two years. During this latter course he accompanied the United States expedition to New Zealand to observe the transit of Venus. In 1875 he was appointed Assistant Profesor of Geology at Columbia University, and in 1892 he was given the Professorship of Geology at the University of Michigan.

Professor Russell's career as a professional geologist began in 1878, when he served as Assistant Geologist on the

United States Geological Survey west of the one hundredth meridian. Two years later he was appointed Geologist on the survey, working subsequently in the Rocky Mountains, the Southern Appalachians, and in Alaska. In 1879 he had visited Alaska, ascending the Yukon, and thence making his way overland to Lynn Canal. In 1890-91 he led the expedition to Mount St. Elias, and made valuable contributions both to geology and to geography.

Among his more technical geological works are: Geological Reconnaissance in Central Oregon (1883); Geological History of Lake Lahontan (1885); Quarternary History of Mono Valley, California (1887); Subaerial Decay of Rocks (1889); A Second Expedition to Mount St. Elias (1892); and, Present and Extinct Lakes of Nevada (1895). Aside from the attention attracted by his study of the ancient Lake Lahontan, Russell is probably most widely known through his more recent studies of North America. The books in this series are more geographical than geological in nature, including: Lakes of North America (1895); Glaciers of North America (1897); Volcanoes of North America (1897); Rivers of North America (1898); and, North America (1904). Taken together, these books represent one of the most valuable of all contributions to regional geography.

Professor Russell was not an old man. Death came at the full height of his career, when years of earnest labor had enriched him with a fund of valuable knowledge gleaned from experience in many fields. It is to be deeply regretted that he had to leave his work uncompleted. But in his death he left his chosen science richer than he had found it: he had seen it advanced by the products of his own labor; in works to live after him as monuments to his memory.

EDITORIAL

Early in the morning of April 18th the region within a radius of about fifty miles from San Francisco was visited by a severe earthquake shock. In the course of a few minutes an unknown number of lives and hundreds of millions of dollars' worth of property were lost. Before noon the news of the disaster was known all over the country, and in every Atlantic coast city special bulletins were issued by the newspapers, giving the story to the public. Safe it is to say that in almost every mind the realization of the extent of the disaster was followed closely by a question as to what could have been the cause. "Explanations" and "full accounts" have not been lacking in the weeks that have ensued. But the conservative geologist has talked only in general terms, while he awaits the results of the careful scientific investigation now being carried on by a corps of experts, among whom are Professor A. C. Lawson, of the University of California, and Dr. G. K. Gilbert and his colleague, Dr. J. C. Branner, of the United States Geological Survey.

The question of exact cause is, of course, still largely a matter of speculation. In assigning causes for earthquakes there is from the very nature of the question wide opportunity for differences of opinion and the expounding of a great variety of hypotheses. But these primal causes, diverse as they are, fall roughly into two groups: first, causes from volcanic action; and second, causes arising out of tectonic, or earth movement, forces.

The inter-relation of volcanic action and earthquake shocks is generally recognized throughout the world of geology to-day. The popular familiarity also is reflected by the widespread speculation about a possible connection between the eruptions of Vesuvius and the San Francisco 'quake. It is a well-established fact that lava in eruption contains a large quantity of super-heated water or steam under pressure, which may give rise to violent explosions. It was such an explosion which marked the famous eruption of Krakatoa in 1883, blowing off the entire top of the volcano and giving 150 fathoms of water now, where there had been dry land. The recoil from volcanic explosions causes earthquake shocks to be felt often over many miles. The undoubted relation of volcanic eruptions and earthquakes has been manifest to every one in the accounts of the recent activities of Vesuvius.

But the other class of earthquakes is apparently just as distinctly not closely associated with volcanic activity. For this class other explanations have been adduced. There is undeniable evidence of extensive wrinkling or corrugation of the earth's crust, which has been explained as due to secular cooling, change of oblateness, loss of water and gas, and in various other ways. Whether one cause has operated alone, or several have been combined, is hard to prove. The fact remains, however, that, in the wrinkling, stresses have accumulated sufficiently to build great mountain systems and bring about much movement of the earth's superficial crust.

Arguing from the basis of accumulated stresses, it has seemed reasonable enough to suppose that at times, under favorable conditions, the relief from the accumulated stresses comes with a sudden rupture, and that the resulting sudden adjustment would set up and propagate a wave or a series of waves known as earthquake shocks. Hence it is commonly accepted by most geologists that a large number of the second class of earthquakes are but incidents in the readjustment of the earth's crust to changing conditions of pressure. These are the earthquakes of tectonic, or dislocation, origin, and, as far as geological results are concerned, they are of extremely small significance when compared with the imperceptibly slow, yet greater, earth movements which have taken place in the past and are now taking place without violent results.

A great variety of other theories have been advanced to account for earthquakes of non-volcanic origin. Their virtues and their faults alike lie in the fact that they can neither be easily proved or disproved. Among some of the most common are: the influence of the heavenly bodies—the varying attraction of sun and moon producing a tide in the fluid interior of the earth, which, acting on the solid crust, produces fractures and hence shocks; variations in atmospheric pressure, increasing or decreasing the superincumbent load on the earth's crust; fluctuations in temperature; excessive rainfall; shifting of the polar ice cap; and the omnipresent appeal to sun spots. Practically all of these hypotheses, however, make dislocation the proximate cause of shock, and differ only from the idea of processes of tectonic adjustment by seeking the primal cause in extra-terrestrial agencies.

Not enough is known yet concerning the real details of the shock at San Francisco to be able to give definitely its immediate cause. California is an earthquake country. Slight shocks, or earth tremors, of sufficient force to be perceptible without the aid of instruments, have been frequent in San Francisco ever since the city was founded. Most of these shocks recorded, numbering well up in the hundreds in the last fifty years, have been relatively unimportant. Others have been more destructive, as the great shock of 1868, in which San Francisco suffered severely; the Owens Valley earthquake, in 1872; the Vacaville earthquake in 1892; and the shock at Mare Island in 1898. California has been an earthquake country because it has been a region of active tectonic processes. That these processes are still in operation is shown by signs of recent slipping along a series of great northwest-southeast fracture planes and by unmistakable evidences of an oscillating coast line.

Whether careful study will show the earthquake to have been caused by further movement along one of the great fractures remains to be seen. Unofficial reports indicate a movement along the San Bruno fault, which runs diagonally across the peninsula, south of San Francisco, from Lake Merced southeast through San Mateo and Palo Alto and northwest through Bolinas and Tamales Bays. Most of the devastated towns lie roughly along this San Bruno fault, but not all of them. The damage in Santa Rosa was heavy, and it lies twenty miles off the fault line. On the other hand, there are reported undouted evidences of lateral movement along the fault, as shown by an offset road in the vicinity of Bolinas

Bay and by a fence near Colma, which had been moved several feet. Further field evidence, with the plotting of isoseismal and coseismal lines now in progress, will doubtless show the true relation between the movement along the San Bruno fault and the earthquake shock.

The effect of the earthquake in the great destruction of life and property has given rise to much discussion concerning earthquake prediction. The chief result of this discussion has been to illustrate how little is really definitely known about earthquake phenomena. The modern science of seismology is largely the result of the efforts of one man, Professor Milne, the inventor of the various instruments for recording and measuring earth movements. In Japan, the frequency and severity of the shocks gives the science an immediate and practical importance and has resulted in a new type of buildings being devised, which resist shocks disastrous to other types of structures in the same vicinity. Neither in this country nor in Europe has the subject received anything like the same amount of attention on the part of the scientist, to say nothing of the engineer and architect.

Ever since the science of seismology has been studied one of the chief aims of the student has been to find some means which will make it possible to predict the coming earthquake. Everyone has already heard the predictions of the false prophets setting date and place for earthquakes which did not come. Yet what these misguided enthusiasts have attempted is only what is required from those who would in all seriousness undertake to forewarn the people of any region that a shock is approaching.

Earthquake prediction to be at all useful must give, like weather prediction, a specific indication not only of the time at which the disturbance will happen but also of the area in which it is to occur. Falb, a German working on the hypothesis of earthquakes caused by tides in the fluid interior of the earth, posed as a prophet. He predicted the destructive earthquake of Belluno, Italy, in 1873, and the eruption of Etna in the following year. In earthquake countries generally, according to Milne, an apprehensive fear of impending danger often leads to the feeling of having actually expected a subsequent shock. In the northern part of South America there are persons locally known as *trembloron,* who are supposed to be endowed with seismic foresight. Nearly every street in Caraccas is said to have a prophet or two whose verdicts are much relied upon. But these rather hit-or-miss attempts are no more than mere guesses, and miss the mark more often than they hit it.

The really serious attempts to find a basis for prediction have been made by earnest, careful workers in various countries as they try to correlate the occurrences of earthquake shocks with other well-marked phenomena. Imperceptible earth tremors, revealed only by delicate instruments, are known to precede the more disastrous shocks. Electrical disturbances also appear to be closely related to seismic phenomena. In the study of these factors seems at present to lie the chief hope of future success in earthquake prediction, with the great saving of lives which reliable prediction will make possible. Whether success will ever crown the efforts of the seismologists time alone can tell. A hundred years ago scientific weather prediction was unknown. To-day it is firmly established. The earthquake problem seems to present more difficulties, and not to offer a close parallel to weather prediction. But whether accurate forecasting of earthquakes will ever be possible or not, it is unquestionably true that experimental investigation will give a better understanding of them and increase the means of making life and property secure.

Note.—The preliminary report just issued by the Earthquake Investigation Committee definitely refers the San Francisco 'quake to lateral movement, or slipping, along the San Bruno fault, the extent of the dislocation being as yet not fully determined.

ACTIVITIES OF THE SOCIETY

MEETINGS OF THE YEAR 1905-6.

Stated Meeting, November 1, 1905.—Annual Address by the President, Mr. Henry G. Bryant: "A Month in Hawaii."

President Henry G. Bryant opened the new year with a few words about the growth and activities of the Society during the preceding year. He also announced to the members of the Society the receipt of further results of the Drift Cask Experiment, a full account of which appeared in the January issue of The Bulletin.

In his annual address, delivered at this meeting, Mr. Bryant gave a graphic account of his journey through the Hawaiian Islands during the preceding summer, presenting a very attractive picture of the beauties of our Pacific territory. His description of the ascent of Mauna Loa, with the accompanying lantern slides, was perhaps the most interesting feature brought out.

Stated Meeting, December 6, 1905.—Mr. H. L. Bridgman gave an illustrated lecture on "The Sudan: Africa from Sea to Center." In his usual interesting conversational way of speaking, Mr. Bridgman held the attention of a large audience throughout the evening. Many excellent pictures were shown illustrative of life and conditions in the Sudan, and especially in the Nile Valley. Among others of particular interest were a number portraying the scenes of General Gordon's campaigns. In his description of the natives and the country, its resources and possibilities for development, Mr. Bridgman showed the question in new lights from those so commonly found in the general public opinion. From his evident powers of comprehensive observation and his familiarity with details Mr. Bridgman's statements carried conviction to most minds.

Intermonthly Meeting, December 14, 1905.—Dr. Henry Skinner told of "A Collecting Trip to the Huachuca Mountains, Arizona," illustrating his remarks with a number of lantern slides. He was followed by Mr. Howard W. DuBois, who gave a short account of the "Rambles of a Mining Engineer in Alaska." As usual, Mr. DuBois supplemented his account with some excellent colored illustrations of mountain scenery.

Stated Meeting, January 4, 1906, President Henry G. Bryant in the chair.—Dr. Otto Nordenskjöld, the leader of the Swedish Antarctic Expedition, on this occasion, gave his first address, after his arrival in America, before an English-speaking audience. The speaker, who is a nephew of the late Baron A. E. Nordenskjöld, gave a *resumé* of the varied fortunes and scientific achievements of the expedition which spent two years in the South and was the first Antarctic party to suffer the loss of its vessel. The main wintering party, numbering six, established themselves at Snow Hill Island, south of Louis Philippe Land, and carried on important magnetic and meteorological observations during their entire stay (1901-1903), and also made sledge trips to the north and south of their headquarters. The speaker described the almost continuous storms which visited the region and which, more than the low temperature, added to the rigours of their experience. The discovery of fossil floras from the Jurassic and Tertiary periods was, perhaps, the most important scientific achievement of the explorers, as it indicated the former existence of a tropical climate on the Antarctic continent and also pointed to a possible former connection with South America.

Owing to the loss of their ship, the *Antarctic,* on February 12, 1903, by ice pressure, the crew were obliged to winter on Paulet Island, while three members of the relieving party, who attempted to reach Snow Hill overland, were also compelled to pass the winter under conditions of great hardship near Bransfield Strait. Dr. Nordenskjold exhibited a fine series of lantern views illustrating the different phases of his work, and concluded by giving an account of the dramatic meeting with the shipwrecked members of the expedition, the rescue of the reunited party by the Argentine gunboat *Uruguay,* and their subsequent return to Buenos Aires and to Sweden.

In the discussion which followed the reading of the paper, Mr. Edwin S. Balch spoke some words of appreciation of the work of the expedition, expressing the satisfaction which we must feel at the speaker's recognition of the early discoveries by American whalers and his sensible adoption of the terms East and West Antarctica in connection with the nomenclature of the region.

Intermonthly Meeting, January 18, 1906.—Dr. John W. Harshberger, in a report on "The Flora of the Bermuda Islands," gave an interesting account of island plant life. The accompanying illustrations furnished many charming views of tropical vegetation, in which Dr. Harshberger pointed out a number of very interesting geographical controls over the character and distribution of plants.

Mrs. Charles Schäffer, the second speaker of the evening, gave a short sketch of a vacation spent in visiting "Newly Opened By-ways in the Canadian Mountains," bringing out both by description and by lantern illustrations added charms of the Canadian Rockies, which are each year attracting more and more members of the Society.

Stated Meeting, February 7, 1906.—"The Geology of South Africa: Notes of a Journey from Cape Town to the Falls of the Zambesi," by Prof. W. B. Scott, of Princeton University.

Professor Scott emphasized the prevailing non-marine origin of the strata over wide areas and through a great vertical range in the geological time scale. Among the most striking, and at the same time most interesting, of these non-marine beds is the so-called Dwyka formation: the great boulder clay beds, concerning the origin of which there has been so much discussion.

Lantern illustrations, both of the Dwyka itself and of the underlying bed rock, showed striations and grooves of ideally perfect glacial character, while the bed rock itself was carved in the typical *roches moutonnees* outlines of an ice scoured surface. The size of the boulders in the Dwyka formation, reaching ten feet in diameter, and the thickness of the beds, said to equal 1,000 feet, are not the least striking features of this greatest of all, yet still unexplained, glacial deposit.

Professor Scott supplemented his remarks by many excellent lantern slides, most of which were from his own photographs taken during his journey in South Africa as a member of the British party in the summer of 1905. Among others of interest were a series of views illustrating the volcanic neck character of the blue sand diamond deposits, and another series showing the gorge and falls of the Zambesi. An interesting feature of the illustrations was afforded by Professor Scott's demonstration of the value of telephoto lenses in doing "long range" geology. Many views taken with the ordinary lens were followed by duplicate views taken with the telephoto lens. The marked contrast between the two furnished a striking and convincing demonstration of the possibility of securing valuable photographs of geological structures and formations from a distance of a score or more miles.

Intermonthly Meeting, February 14, 1906.—At the third intermonthly meeting, Miss Laura Bell gave an interesting personal appreciation of Scotland, and Dr. William H. Moore recounted his experiences during "A Hunting Trip in Mexico and Wyoming and Cave Explorations in the Sierra Madre."

Stated Meeting, March 7, 1906, President Henry G. Bryant in the chair.—The Rev. Charles A. Killie addressed the Society on "Peking: The Siege and the Emperor's Palaces."

From his personal experiences as a missionary in China, and as one of those who went through the siege of Peking, the Rev. Mr. Killie was able to give a highly interesting picture of the incidents connected with the siege.

But as interesting as was his thrilling account of the outbreak, the defense of the British Consulate and the final relief, with the American marines in the lead, the most attractive part of the address was in the description of the Emperor's palaces and the unfamiliar scenes of the "Forbidden City." Accompanying the description was an excellent series of colored lantern slides showing the beauties and splendor of the inner city—objects of intense interest, as things which even a visit to Peking does not make available to the ordinary individual.

Stated Meeting, April 4, 1906.—"Morocco: The Land and the People. My Captivity Among the Moors," by Ion Perdicaris.

Mr. Perdicaris presented a very interesting account of his captivity among the banditti of Morocco. He was especially well qualified to discuss the country and the people of Morocco, because of his long residence at Tangiers and an intimate knowledge of the language and customs of the people. His portrayal of the court of the Shah and of the conflicting interests struggling for control there gave a vivid idea of the sort of politics which has come to be called "Oriental."

The forced trip through the mountains of the interior, with their scarcely traceable passes and half-forgotten villages, furnished a glimpse of country and civilization bearing a strong contrast to our own. In addition to his powers of description, Mr. Perdicaris showed a thorough appreciation of the attitude of mind of the people, which made his hearers feel that he was not only an observer, but also an interpreter of the Moorish character.

Stated Meeting, May 2, 1906.—Mr. Anthony Fiala, leader of the Ziegler Polar Expedition, told of his experiences during two years in the Arctic. The Society has been closely identified with Arctic exploration through its connection with the Peary Expedition and the Drift Cask Experiment. Mr. Fiala's address made one of the most interesting and successful meetings of the year. The personal element entering into Mr. Fiala's descriptions gave a vivid idea of Arctic experience, which was greatly intensified by the admirable moving pictures, the first ever taken in the Arctic regions, showing the embarkation, the disembarking on the ice, dog trains at work and other interesting incidents. To most of the spectators these pictures gave Arctic exploration a reality which ordinary photographs or verbal descriptions could never do.

Annual Dinner, April 21, 1906.—The annual dinner of the Society was given at the Roosevelt, 2027 Chestnut Street, with fifty-eight members and guests assembled at the five tables. The largest table, in the form of a hollow circle, enclosed the emblem of existence of all geographical societies, the globe, surrounded by palms. At this table the President, Mr. Henry G. Bryant, was seated with the guests of honor, among whom were Admiral G. W. Melville; Mr. Willis L. Moore, President of the National Geographical Society; Mr. Gilbert H. Grosvenor, editor of the National Geographic Magazine; Mr. William Libbey, of Princeton, representing the American Geographical Society; Mr. Cyrus C. Adams, President of the Association of American Geographers; Mr. Ernest W. Brown, of Haverford, Pa.; Mrs. Zelia Nuttall, of Mexico, and others.

At the conclusion of the dinner, the President proposed the health of the first president of the Society, Professor Angelo Heilprin, who was absent in the West Indies, and then called for a few remarks from each of the guests, as well as from Professor Emory R. Johnson, the President-elect.

An amicable war of words between Mr. Moore and Admiral Melville in regard to the possibility of reaching that elusive spot, "the pole," in a balloon lent spice to a most enjoyable series of after-dinner speeches. The evening was brought to a close at a late hour by a few well-chosen words from the President.

It is hoped that in the future more members will avail themselves of the opportunity to enjoy a social evening at this annual reunion.

The Entertainment Committee included the following members:

Mrs. P. F. Rothermel, Jr.,
Miss Elizabeth S. Maybin,
Miss Mary S. Holmes,
Miss Laura Bell, Chairman;
Mr. Henry G. Bryant,
Mr. Emory R. Johnson,
Dr. Theodore LeBoutilliere,
Mr. George Vaux, Jr.

The Society.—The year 1905-1906, which ended on May 1st, was one of encouraging growth of the Society. During this time 84 new members were admitted, including one life member, and a large number of books were added to the Library. A large collection of the latest maps and railway and steamship guide books, available at all times in the Society rooms, has added a valuable feature for members planning vacation trips into new regions.

At the first meeting of the new Board of Directors, held in May, 34 new members were admitted, giving promise of still greater growth during the current year.

THE BULLETIN
OF THE
Geographical Society of Philadelphia

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Notes on Northern Mexico: Its Deserts, Plateaus and Canyons.[1]

EDMUND OTIS HOVEY.

Our sister republic of Mexico borders the United States on the south with a boundary line 1,550 miles in length, about 850 miles of which is formed by the Rio Grande. The country forms a giant cornucopia convex toward the southwest, with its broad end toward the north and its small extremity curving up into the peninsula of Yucatan. In area the country is about one-fourth as large as the United States, and it occupies rather less than one-eighth the total land surface of North America. The whole country lies within tropical and subtropical latitudes, but the differences of elevation above sea-level are so great that the climate varies from torrid to cold temperate, and many of the mountains of Southern Mexico rise into the realm of perpetual snow. Politically, Mexico is divided into twenty-seven states, two territories and the capital district. The population of the land is about thirteen and a half millions, having more than doubled during the past century, mainly from natural increase, since there is comparatively little immigration. Indians of pure blood, probably the direct descendants of the ancient inhabitants of the land, form thirty-eight per cent of the population, whites form nineteen per cent, and the remainder is of mixed blood.

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[1] A lecture delivered to the members of the American Museum of Natural History, New York City, November 23, 1905.

Twenty-one years ago Mr. A. F. Bandelier, then carrying on explorations for the Archæological Institute of America, crossed the Western Sierra Madre forty miles south of the international boundary, and, turning southward, studied the prehistoric ruins as far as a point thirty-five miles southwest of the famous Casas Grandes of Chihuahua. Bandelier penetrated nearly to the high plateau of the Sierra Madre before he was obliged to turn back, and he writes regarding the region:[2] "If the interior of the Sierra Madre is ever opened to travel and civilization, it will be found prolific in resources of divers kinds, and as interesting to the naturalist as to the student of archæology."

Fifteen years later, Dr. Carl Lumholz pursued anthropological investigations for the American Museum southward from Casas Grandes through the country of the Tarahumare and the Huichol into the states of Sinaloa and Durango. He traversed the eastern part of the Western Sierra Madre. Here and there, too, mining engineers have examined bits of property for individual or corporate mine owners, but their reports rarely contain structural data, and are seldom accessible to the public. No correct map of the mountains and rivers is in existence, and in spite of the investigations already mentioned, the heart of the Sierra Madre, at least in western and southwestern Chihuahua, is practically a *terra incognita* to geologists and geographers. Thousands of square miles within this region were left uncolored on Castillo's geological map of Mexico (1890) as being unknown. On account of the prospect, therefore, of traversing practically virgin territory, the authorities of the American Museum of Natural History permitted the author to accept the invitation extended by Mr. W. C. Greene, an American capitalist and mine owner, to participate in a geological reconnoissance of his concession in the center of this great and almost unknown region, under the leadership of Prof. R. T. Hill, formerly of the United States Geological Survey. The observations of several interesting weeks in February, March and April, 1905, form the basis of this article. The Greene tract comprises some 4,000 square miles in the midst of the Sierra Madre in western Chihuahua. The size and importance of this concession can best be apprehended when we consider that it covers an area about half as great as New Jersey, or nearly equal to Connecticut, and that it includes some of the richest parts of the Sierra Madre in the line of agricultural, mineral and timber resources.

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[2] "Investigations in the Southwest," Part II, page 563.

The route followed by our party lay southwestward from El Paso, Texas, for 150 miles by rail to the town of Nuevas Casas Grandes, the terminus for trains of the Rio Grande, Sierra Madre and Pacific Railway. Thence we went on horseback and muleback by way of San Diego and San Miguel to Dedrick, thence to Guaynopita, Dolores, Cerro Boludo and Ocampo, our extreme southern point. From Ocampo we turned back and rode by way of Pinos Altos and Tomochic to Miñaca, the terminus of the railroad to Chihuahua, where we reached the Mexican Central for our return to El Paso. In addition to this, my itinerary included visits to the great copper mines of Phelps, Dodge & Co., at Bisbee, Arizona, and Nacozari, Sonora, and to the comparatively new copper mine of the Greene Consolidated Copper Co., at Cananea, Sonora.

The moment one crosses the Rio Grande at El Paso and enters the city of Ciudad Juarez, he realizes that he is in a foreign country. The bustle and hurry of the United States have been left behind, and the traveler at once encounters the deliberation of Latin America, where "mañana" is always the best time for doing anything. The picturesque sombrero, bright-colored sarape and bell-bottomed trousers of the Mexican crowding the streets form striking contrasts to the somber and more conventional costumes of the American city just across the river.

Leaving El Paso early in the morning of the fourteenth of February, our special train halted at Juarez long enough for the deliberate Mexican customs officials, with the aid of the usual gaping crowd, to examine and pass our scientific instruments, saddles, bed rolls and other baggage, and then started on into the, to me, strange territory.

Skirting the eastern and southern sides of Juarez mountain, within an hour we found ourselves passing over the sharply defined edge of the great mesa, or table land, bordering the valley of the Rio Grande. The mesa here, like that west of El Paso, is a sandy waste, which is practically a desert for lack of water. For the most part, however, the arid or semi-arid region is not without its vegetation and its animal life. The mesquite tree and the scanty sage bush are seen in every direction. The mesquite is a remarkable example of adaptability to circumstances. Under favorable conditions it looks like any ordinary low, scrubby tree, but in the semi-arid mesa, where the scanty supply of permanent moisture is ten or fifteen feet or even more below the surface, the mesquite is buried in the sand up to its branches. These retard the progress of the drifting sands and form a mound. From the appearance of these mounds alone one would form the erroneous opinion that the mesquite was only a bush. The greasewood, or *Covellia,* is another characteristic plant of the desert. Usually a bush, it becomes a tree under favorable circumstances. It is full of tarry resin, making it valuable for fuel.

The kangaroo rat, the gopher and other small mammals, a few snakes and several insects make up the population of these dry regions.

We soon perceived that we had left the drainage basin of the Rio Grande, for the mesa sloped gently toward the west. Thirty miles from El Paso the railroad enters the belt of drifting sand hills known as Los Médanos. Before the advent of the iron highway the stretch of twenty miles across these soft, shifting sands was the terror of travelers between El Paso and the central portion of Mexico. Beyond the Médanos the mesa presents flat stretches of barren, hard sands, with here and there a shallow basin containing a more or less permanent supply of water. These basins are known as *lagunas,* and some of them are of considerable extent. The pools act as "settling tanks" for wind-driven sands, and have played an important rôle in the upbuilding of the mesa.

Our route to Casas Grandes lay through a series of bolsons, or pocket deserts, one a little above another, as we went southward. These bolsons lose their aridity toward the south, and are fertile where susceptible of irrigation.

At Nuevas Casas Grandes, we really began our long journey through the mountains and forests, making first of all, however, a detour to the old Mexican town of Casas Grandes, where are located the most extensive prehistoric ruins to be found in the State of Chihuahua. These adobe buildings are of pre-Columbian age. The relics found indicate a comparatively advanced state of civilization for the people who once occupied them. The ruins cover a space several acres in extent, and are supposed to have housed a population of not less than 4,000 souls (Bandelier). The adobe of which the walls were built consists of the red clay of the district, mingled with gravel and laid in troughs, one tier being allowed to set before the next tier was laid atop of it, just as concrete buildings are put up to-day in our own and other countries. Modern adobe is made into large bricks and is not nearly as durable as the ancient.

Pushing southward up the Casas Grandes River, just at nightfall we reached the hacienda of San Díego, one of the many estates belonging to General Luis Terrazas, a hero of the Mexican contest against the French, and for many years Governor of the State of Chihuahua.

General Terrazas is probably the largest private individual land-owner in the world. His haciendas follow one after another so that one could travel more than 200 miles in a straight line in the State of Chihuahua without setting foot outside his land. His cattle are literally upon a thousand hills, and are so numerous that it is said that even he himself has no idea of the numbers in his herds. San Diego is one of the most northern of the Terrazas haciendas. At the time of our visit a new manor house was nearly completed. It is one story high, and about 150 feet square, built around an open patio or court yard. Existence on these estates is one of almost feudal simplicity, each hacienda being practically self-supporting. In supreme control is an *administrador* or factor, and under him there is a little army of servants and laborers.

The principal crop is corn, or maize, and this forms one of the chief articles of diet for both man and beast. Cattle and horses are the staple production of the region, and at San Diego General Terrazas has built a stone-walled corral more than two acres in extent and capable of holding 2,500 steers at one time. From this hacienda come some of the best bulls to make sport for the morbid crowds which attend the bull-fights at Ciudad Juarez. The existence, however, of these enormous individual estates has been a great hindrance to the development of Mexico.

At San Diego the Rio de Piedras Verdes comes in from the west and joins with the Rio de Palanganas, or Rio de San Miguel, to form the Rio de Casas Grandes. Mexican rivers have an exasperating abundance of names, every large stream rejoicing in several, according to the number of communities or haciendas along its banks. Corralitos, Casas Grandes, Palanganas and San Miguel are names applied to different parts of one and the same river not 200 miles long, which we followed most of the way to its source on the high plateau. From San Diego we went southward along the San Miguel River through a beautiful fertile valley which preserves here and there on its sides the "*trincheras*" or low stone walls which acted as dikes and assisted the prehistoric inhabitants in preserving and irrigating their fields. In about ten miles we plunged into the canyon of the San Miguel. This great gorge has been carved to a depth of 1,800 or 2,000 feet through a succession of great flows of lava alternating with beds of volcanic ash. Here and there we saw in the face of the vertical cliffs walled caves which were once the abodes of the inhabitants of the region.

Leaving the canyon on the following day we climbed up to a high plateau at an elevation of 2,000 feet above Casas Grandes, in the midst of an extensive plain known as the Llano Cristo. This plain is one of those which form the high plateau of Mexico. The main mass of the mountains is of volcanic origin, and consists of innumerable lava-flows and beds of volcanic ash, rhyolites, andesites and basalts. Between the hills thus formed there were constructional valleys or depressions, and these have been filled by the débris brought down from the surrounding mountains through the influence of frost, water and wind, until great level expanses have been formed.

A hard ride brought us to San Miguel, one of the estates of General Terrazas. The buildings of the ranch form a veritable fortification, and were built thus to resist the attacks of the Apaches. Continuing our journey southward through a rolling country covered with live-oaks and scrubby pines, another twenty-four hours brought us to the great plain known as the Llano Bavicora, the most fertile portion of the million-acre Chihuahua estate belonging to the Hearst family. This plain is some thirty miles long from northeast to southwest and from fifteen to twenty miles wide, and is as level as a floor. Promontories of ancient rhyolite and basalt jut out into it like headlands into the ocean.

The great plateau of Mexico slopes gently from the south toward the north. The great block of land has almost parallel sides running from southeast to northwest, and is bounded on the east, south and west by mountains. Above the plateau there rise the partly buried peaks of ancient volcanoes, and upon it, along the southern edge, stand the vast piles of the well-known active volcanoes Orizaba, Popocatapetl, Ixtaccihuatl and others. The principal relief of the Western Sierra Madre results from the erosion which has carved vast canyons in the edge of the elevated plateau. These canyons discharge their waters into the Pacific, and their rivers are gradually cutting their way back to the inclosed basins of the interior, which they will eventually drain. Up to the present time no railroad has succeeded in the effort to descend from the high plateau to the Pacific plain.

We reached the Llano Bavicora just at sunset and had an invigorating ride of five or six miles across the level expanse in the light of the full moon, before reaching a hut at Los Ojos, or "The Springs," where we were hospitably provided with the Mexican standard diet of *frijoles* and *tortillas,* and were allowed to spread our camp-beds under the protection of the covered courtyard.

The national diet of the Mexican peasant is very simple, consisting of the brown flat bean called the frijole, which is usually served stewed, and the tortilla. The typical tortilla is made of meal prepared from corn which has been soaked in strong lye until the hull peels off and the grain swells. The grain is then placed upon a flat stone known as a metate, where it is ground to a fine, mealy pulp by means of a cylindrical or prismatic stone like a rolling-pin. The metate has been in use in Mexico from time immemorial, and is one of the commonest objects found among ruins. It is always made from cellular rock, giving a good grinding surface, and such material is abundantly furnished by the lavas of Mexico. The best metates are mounted upon four legs so arranged that the top of the stone slants away from the operator.

After a sufficient quantity of the cornmeal paste has been prepared, the woman takes a little lump of it between her hands and dextrously pats it into a thin cake several inches in diameter and about an eighth of an inch thick. This she casts upon an iron plate supported above glowing coals which have been drawn out from the wood fire in the great fireplace, and the baking is performed in a few minutes.

The primitive character of the Mexican peon is shown farther by his method of plowing. A wooden plow is employed, which has been formed from the knee of some tough tree like the oak. Sometimes the plow is pointed with a bit of iron. The implement is guided by means of a single handle. Improved American farm machinery has made but slow progress yet in Mexico.

On the sixth day out from Casas Grandes the four-mule freight wagon and four-mule "hack" which had joined our party at San Miguel got hopelessly mired, one on the open prairie and the other in the middle of a little stream, so that at sunset we found ourselves in the midst of a forest six miles from our destination—the new "city" of Dedrick, a lumber camp. We had no food with us, and consequently were obliged to press forward in the darkness, avoiding bogs, fallen logs, low branches and hidden boulders as best we could. We arrived at camp at 9 o'clock, a tired, hungry and discontented set of travelers. Our arriving party consisted of fifteen men, including geologists, mining engineers, journalists, railroad contractors, timber cruisers, and camp rustlers. We were cordially welcomed by the company's agent and his wife, and the rousing fire of pitch pine logs and the accompanying bountiful supper soon made us forget all the discomforts of our journey. Dedrick is a city of the future. At the time of our visit it consisted of six log cabins, only one of which, a double one containing four rooms, was really ready for habitation.

The town is situated in the midst of a magnificent open forest of long-leaved pine at an elevation of about 7,200 feet above the sea. This forest is one of the prime resources of the region, since it lies nearer to the great mines of southern New Mexico and Arizona and northern Sonora by a thousand or fifteen hundred miles than do the forests of Washington and Louisiana, from which these mines now obtain their supplies of timber. The inaccessibility of the Mexican plateau has been its sole protection, but the needs of the great mining corporations and other devourers of timber are overcoming the difficulties which have thus far prevented the destruction of the forests.

The pack train which had been ordered to meet us at Dedrick did not materialize, hence we sent a man post-haste to Miñaca, 125 miles distant, to get an outfit and join us at Guaynopita, in the Aros Canyon, while our party, now reduced to its original four and some helpers, started westward through the forest toward the rendezvous. We crossed the so-called Continental Divide at an elevation of 8,400 feet. Our visit had been timed for the dry season, but the season seemed to be abnormal, and we encountered abundant rain and plenty of snow, in place of the dry weather that we anticipated. The term Continental Divide is a misnomer, at least as far as the Western Sierra Madre is concerned, for, among other considerations, the division is not between the Atlantic and Pacific drainage, but between Pacific and interior drainage, and even at that is very vague.

Immediately beyond this point we obtained our first view of the great canyon of the Aros, to visit which was one of the objects of our expedition. We found ourselves looking across a maze of ravines and gorges eight or ten miles wide and more than 5,000 feet deep, in the bottom of which was the river Aros, which with its tributaries had carved the complex system out of the elevated plateau. The Aros is the principal tributary of the Yaqui River, and its waters find their way through that stream into the Pacific Ocean. After a short time devoted to the magnificent view spread out before our eyes, we began the descent through the tangle of side gorges to the great river 4,000 feet below us, which we reached in the afternoon of the following day, at the place where the trail is supposed to cross by means of a ford. We found the river a boiling flood on account of the recent rains, and utterly unfordable, hence our first task was the construction of a raft.

Next morning we accomplished the transfer of ourselves and our impedimenta across the river. Before the floods came a good rope had been stretched across the stream and tied to trees on either bank. This was now available for our use. Tying this to one end of the raft and a rope which we had brought with us to the other end, we pushed the frail contrivance out into the stream with its load, and the current soon swept it to the opposite shore. Our raft would scarcely support with safety and comfort a load of 300 pounds, hence many trips were made before everything was safely landed on the farther bank.

We had been in a region of snow, ice and frost at Dedrick, but when we passed over the divide and began to descend into the canyon we found ourselves in a different climate. The willows and aspens had already begun to put out their leaves and a dozen beautiful flowering plants were in bloom in secluded nooks, but all were strangers to northern eyes. Resurrection plants were abundant—those curious products of the vegetable world which dry up and look dead in the absence of water, but which open and turn green within a few hours after the rains begin. There are many kinds of such plants in Mexico. At the ferry the immediate banks of the region were very steep, without being actually precipitous, and the rocks, where not covered with the sparse vegetation, were weathered into warm tones of brown and red.

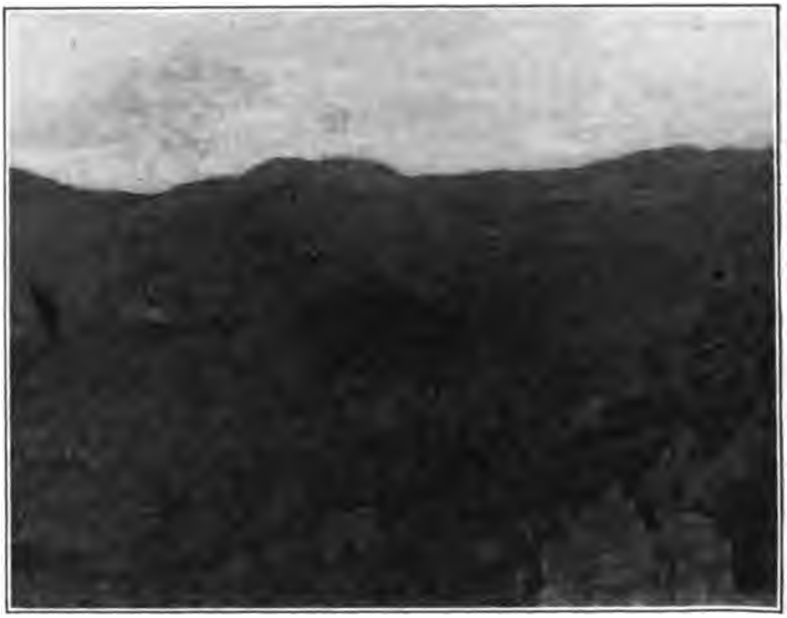

FIG. 1. The Aros Canyon in the Western Sierra Madre of Chihuahua, Mexico. The river at the left is 1,640 feet below the point of observation; the distant rim of the canyon is at least 5,000 feet above the river.—*Photograph made for American Museum of Natural History, February 26, 1905, by E. O. Hovey.*

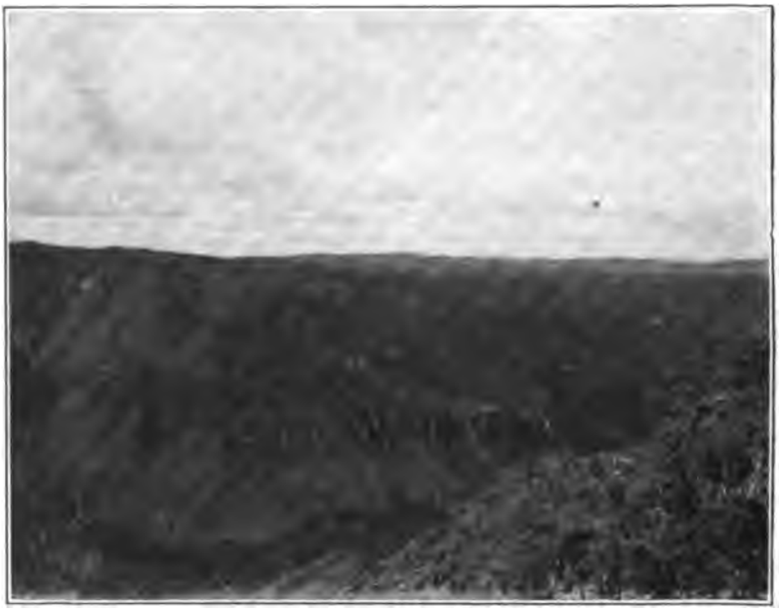

FIG. 2. The Aros Canyon at Guaynopita, showing Ordóñez Butte in the foreground and Candelaria Mt. in the background at the left. The river is 3,280 feet below the point of observation.—*Photograph made for the American Museum of Natural History, March 11, 1905, by E. O. Hovey.*

Crossing the flooded river occupied so much time that we did not advance more than two miles down the Aros before going into camp. The canyon had now narrowed so that there was scarcely room for the trail between the great precipices of red volcanic rock and the river. Opposite a great cliff of rhyolite, a thousand feet high, the trail turned sharply to the south and climbed out of the canyon by so steep a grade that our scientific leader slipped, saddle and all, over his horse's tail and found himself sitting in the path in a most undignified and dangerous situation in the midst of the cavalcade. Advancing along a side gorge, a ride of a few miles brought us once more to the edge of the great canyon and spread before our eyes views which are scarcely to be surpassed even in the Grand Canyon of the Colorado.

All the rocks in view were ancient lavas and ash beds, and betokened the extreme volcanic activity of the region in bygone ages. No estimate has been made of the number of the eruptions, but nineteen distinct flows were to be seen in one of the side canyons which we traversed, and this could be only a fraction of the total number.

The trail wound for half a mile along the edge of the plateau overlooking the river and then began to descend rapidly into the portion of the gorge in which the mining operations of Guaynopita are carried on. The canyon has widened somewhat here through the entry of the Arroyo Haciendita from the south. We were now approaching the very heart of the Sierra Madre.

Our three days of travel from Dedrick with inadequate supplies and poor equipment made the sight of the mining company's brown adobe house and store at Guaynopita more than grateful to us. The latter, a small building about twenty feet square, was placed at our disposal for a dormitory; the other of the two buildings was occupied by the assayer and his wife and one of the owners of the property.

In the assayer's wife we found a delightful hostess, who, with native American pluck (she was an Iowa girl), made the best of the hard conditions in which she found herself, and with the aid of her little Mexican *mozo* or servant, Demetrio, kept us all good natured during the ten days that we had to wait for the arrival of our pack train. Cooking was done over a little four-holed wood stove, and the "china" consisted of tin pie plates for service, empty butter tins for soup dishes and condensed milk cans for cups, but we had good, stout steel knives and forks with which to do execution. A bottle did duty as a rolling pin. The difficulty of housekeeping in this region, however, lies not so much in the lack of utensils as in the lack of fresh, wholesome food, for the latter is hard to get in a mining camp ten days by pack train from the nearest railroad station.

Tales of the fabulous wealth of the old silver mines at Guaynopa in these mountains have led to the loss of many lives in their attempted rediscovery. Guaynopita, or the little Guaynopa, is only seven miles from the supposed location of old Guaynopa, and is another of the mines which was worked by the early Spaniards and abandoned when the difficulties of exploitation were too great for the primitive methods employed by the miners, or when hostile Indians were too threatening for safety.

A little creek which flows past the company buildings has its origin on the high mesa above the Cobriso Peaks. Palm trees line its lower reaches near the Aros, while its head waters, 3,000 feet above the river, are in far too cold a region for anything but pines and similar vegetation.

The vegetation of the canyons partakes in part of the character of the semi-arid regions, since the lower parts of the gorges do not receive as great a rainfall as the high mesa, and moisture is frequently abundant only near the water courses. The number of thorny plants is surprising. The *yucca* in its various forms is characteristic, one of the finest being the kind with a tall tree-like trunk. The *Spanish bayonet* variety of the yucca is always on the defensive, while the *sotol* is like the Spanish bayonet, only worse, because of the spiny edges of the leaves.

The innumerable varieties of cactus are a constant menace to the unwary traveler. Among the worst of the cacti is the familiar prickly pear, a plant, however, that will be of the highest value as fodder for cattle if cultivation of the variety without spines is undertaken as a result of Burbank's wonderful experiments.

The great *maguey,* or American agave, a member of the century plant family, is another of the plants of which it is well to beware, since the thick, heavy leaves terminate in hard spines as sharp as needles. I was interested one day to see a Mexican who had unwarily taken hold of a cactus break off a spine from a maguey and proceed to use it in digging out the cactus spines which had become imbedded in his flesh. The maguey is cultivated on a large scale in many parts of Mexico for the manufacture of the national fermented drink *pulque* from its juice, and for the making of *mescal* by the distillation of pulque.

There are many other forms of the agave, one that we noticed upon the high plateau had short, fat, compressed leaves, and a habit of growth which made it look like an exaggerated French artichoke. The *ochatilla* is another characteristic denizen of the southwestern arid regions. It is a scraggly, terribly thorny bush belonging to the *Tamarisk family.* It is barren of leaves most of the year. One of the strange plants seen at Guaynopita was a tall, woody bush bearing flowers like our common sunflower.

On the 10th of March our pack mules and supplies arrived from Miñaca after a terrible ten-day journey through rain and sleet in the boggy forest. The animals were worn out, but we could not give them time to rest, and after a day spent in adjusting the loads, we set out for our trip southward through the mountains. Although we were glad to be on the march again, we were loath to leave the beautiful surroundings of Guaynopita, and we stopped often to look at the constantly changing views as the trail led us up the side of the Arroyo Haciendita out of the great canyon and onto the high plateau more than 3,000 feet above the little mining camp. Under ordinary climatic conditions camp life on the high mesa of the Sierra Madre, particularly late in the winter and early in the spring, is full of enjoyment to those who like this kind of existence. Our camps were very simple affairs, since we never stayed more than one night in a place, and when rain did not threaten we did not even go to the trouble of putting up our tents.

On leaving Guaynopita we discarded horses altogether, and made use of mules as being more sure-footed and reliable on the steep mountain trails than any horses obtainable. The vagaries of the average pack-mule are past finding out to one not used to their ways, and more than once I saw my baggage and photographic outfit endangered by the mule's desire to roll in the dust and thus rid himself of his load. The woods abound in game, especially quail, turkey (which is supposed to have originated in Mexico), and deer, with an occasional bear and mountain lion. Our cavalcade was too large, however, for us to see much of this wild life.

On the high mesa south of Guaynopita and on the divides showing the former extent of the plateau we encountered again the magnificent pine forest already spoken of in connection with the new town of Dedrick. The vegetation in the mountains grows approximately in zones dependent upon the altitude above the sea. The best marked of these zones perhaps are those of the live-oaks and the pines. The live-oaks occur between the altitudes of four and six thousand feet, gradually becoming more scrubby on the higher slopes, where an oak coppice looks like an orchard of old apple trees. Between six and seven thousand feet above the sea the oak gives place to the jack pine, while above seven thousand feet the long-leaved pine is in its prime. These magnificent trees grow in an open fashion with luxuriant *gramma* grass filling the interspaces, so that a delightful park-like effect is produced. The full-grown pines are 150 to 175 feet high and 4 to 6 feet in diameter at the butt. Often it is fifty or sixty feet to the lowest branches.

Our route led us for four days in a south-southeasterly direction through this wonderful forest on the high mesa, which varied in width from a narrow divide to a nearly level plateau a mile or more across. Upon the east we had the canyon of the Aros, while upon the west we looked down occasionally into the almost equally extensive canyon of the Tutuaca, the principal tributary of the Aros. Just before sunset of the fourth day we reached the ancient trail from Miñaca to Dolores

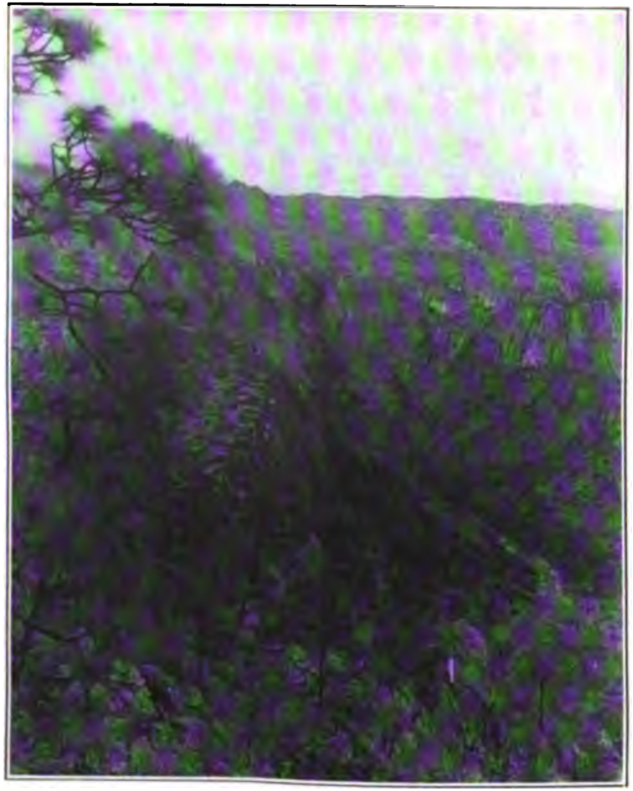

FIG. 3. The Aros Canyon. The river is 1,640 feet below the point of observation.—*Photograph made for the American Museum of Natural History, February 26, 1905, by E. O. Hovey.*

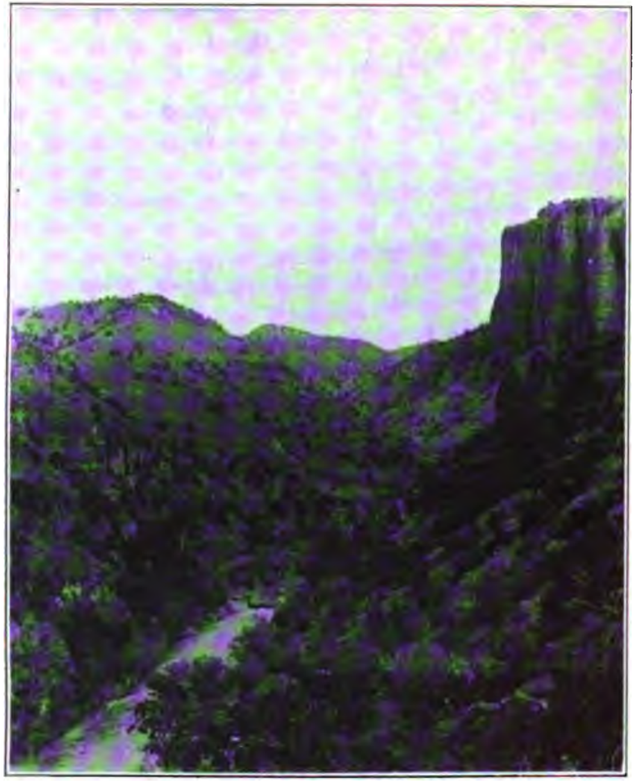

FIG. 4. The Tutuaca Canyon, Western Sierra Madre, Chihuahua, Mexico. The Tutuaca is a tributary of the Aros, and the view was taken near Dolores. The immediate gorge here is about 1,200 feet deep. *Photograph made for the American Museum of Natural History, March 16, 1905, by E. O. Hovey.*

and the west, where it crosses the great Mesa Venado. We had been making our way through the trackless forest for so long that this trail looked to us like a great highway. Turning abruptly to the west we came to the edge of the Tutuaca canyon just as the sun was setting below Dolores Mountain, fifteen miles away on the other side of the river. The scene was one of magnificent beauty.

Fifteen miles on the map across such a country as that bordering the Tutuaca is a deceptive measurement, since the trail goes up and down so many times that it took us nearly a day and a half to accomplish the distance.

Starting early from camp on the morning of the 16th of March, we rode forward for Dolores, leaving our pack train to come at its leisure, and first we plunged downward into the lower reaches of the great Tutuaca gorge, aiming for the crude suspension bridge over the swift river which is more than a hundred feet wide and too deep for fording in this part of its course. Pack trains are unloaded on the east side of the river and the cargoes are pushed across the bridge on a little tram car and loaded upon a fresh train in waiting upon the other side.

Transportation is a serious and expensive matter in any mountainous country. The problem has been solved for centuries in Mexico by use of pack trains of burros and mules. The trail across the Tutuaca canyon to Dolores is a great highway which has been used for generations, and we encountered there scores of pack trains carrying machinery and supplies toward the west and returning light for additional cargoes. It was astonishing to see what heavy loads were carried with comparative ease by the little burros and rather small mules. We saw one train transporting six-inch iron water pipes, two such pipes forming a load for a burro or four for a mule. These tubes seemed awkward enough, but the sections of the great pen-stock for the power plant were even worse.

The small sections of the heavy castings of engines were still harder to manage on account of the difficulty of tying them securely to the *apparejos,* which, in Mexico, take the place of the pack saddles of the United States. In the great mill in Dolores, which was the destination of the machinery, we noticed that the bed plate of the dynamo and other particularly heavy castings had been broken into pieces in order to divide the masses into loads which would not be too heavy for the mules. The most awkward load of all perhaps is a section of a steam boiler. This weighs about 380 pounds when packed, and it goes on the back of the patient mule like the shell of a turtle. Woe betide the mule with such a load if he should make a misstep, for the cargo is top-heavy and the corners of the boiler plate, though protected, are sharp and are liable to break his leg.

The usual cargo weighs about 300 pounds, but the main shaft of the new mill at Dolores was brought in as a single piece weighing 480 pounds. The most picturesque load for a pack train is a long wire cable. The cable, of course, cannot be cut, hence it is packed in coils, each of which is sufficient for a load, and free rope enough is left between coils so that the cable can be placed upon the backs of twenty-five or thirty mules, and thus be transported over the mountains. When one considers that the zig-zags of a trail are sometimes so short that but one animal at a time can be upon a given section of the path, it is readily understood that it requires skilful management to deliver such a consignment without accident.

Dolores, like most other Mexican mining camps, was established by the natives, and mining was carried on in primitive fashion by them or by the Spaniards many years before American mine owners took hold of the proposition. At the present time, even, the peon is the one usually encountered in the actual work of handling drill and sledge. The Mexican prospector requires very few tools. He breaks off the rock with a hammer, either of iron or stone, reduces it to small fragments by further hammering, and then grinds it to a pulp by hand with one stone upon another.

Climbing out of the arroyo in which the town of Dolores is situated we attained once more the beautiful high mesa and continued our journey southward. The valleys are full of interest to the geographer and the geologist. Here and there we passed great mineralized veins standing out like walls or buttresses from the mountain sides, traversed dark canyons carved out of the black basalt of the region, or passed beneath beetling cliffs of volcanic ash. Most of the region is uninhabited, but occasionally there is a little alluvial plain in the mountains like the Las Animas Ranch, where some squatter has settled and is trying to eke out a humble existence by tillage of the soil.

Rain, frost and wind have been busily at work in the Tutuaca canyon, undermining the white cap-rock of volcanic ash and causing it to fall in immense blocks. These blocks, in their turn, have been carved into all sorts of fantastic fragments by the action of the elements. One could trace out many fanciful resemblances to animals in the shapes assumed by these enormous masses.

Late in the afternoon of the third day out from Dolores we rode into the little Indian village of Yepachic, one of the most important settlements of the Pima Indians, a tribe investigated by Dr. Lumholtz. The main building in the town is the old adobe church, with its curious, incomplete stone belfry on one corner. The unpainted doors show some attempt at carving. Strange to say, for a Catholic country, the church was closed and locked. Inquiry elicited the information that the priest visits the village only once a year, but he always comes that often to solemnize marriages, baptize the new children, say prayers for the dead and collect his tithes.

The village jail is an unpretentious structure in the middle of the main street, apparently without a jailer and without inmates. If drunkenness, however, had been regarded as a crime the jail would have been full, since it seemed to us that every male inhabitant of the little village imbibed more than his capacity of *mescal* during the evening and made night hideous with his shouts, as he pursued his devious path homeward.

Turning westward from Yepachic we soon left the region of plateaus, and as far as we could see from eminences, there was nothing but a maze of canyons, arroyos and sharp divides in every direction. Cerro Boludo, or Bald Mountain, was one of our objective points. Here we found that extensive development work had been done in the great mineralized vein cutting through the mountain. Since our visit this has become a center of mining activity, and the face of the country is rapidly changing.

Turning southward from Cerro Boludo, a short ride brought us to a little two-stamp mill and old-fashioned arrastre in the picturesque Arroyo San Francisco. The arrastre consists of a circular bed paved with large, flat stones, into which is led the pulp from a stamp-mill or other breaking device. Over the pulp in this bed heavy stones are dragged round and round, reducing the ore to a sufficiently fine state of sub-division for treatment with mercury for the extraction of gold. Many remains of such primitive mills are to be found throughout the mountains, testifying to the industry of the Mexican miner.

Seven hours' ride southward from Cerro Boludo brought us to the brink of the great gorge of the Rio de Moris, 4,000 feet deep and eight miles across. We were getting into a hotter and more arid region, the beautiful red madroña tree, which we saw frequently in the forests on the high mesa, had given place to the green-barked tree known as the Palo Verde: the spiny ochatilla, now become a tree, reappeared; cacti became more numerous, and we realized that we were in a different climatic zone.

Descending into the canyon, we passed little ranches on the mountain side where ground had been gained by means of retaining walls and irrigation was possible on a small scale. The ground is fertile wherever water can be brought to it. Late in the afternoon we rode into the beautiful orange and lemon grove of the Hacienda Navosaigame and regaled ourselves with delicious large oranges at a cent and a half apiece, and bought fresh lettuce and young onions at ridiculously low prices. For more than five weeks we had not been able to get any fresh vegetable except potatoes, and the change was very welcome. The oranges, lemons and other products of these scattered ranches in the bottoms of the canyons are carried by pack train into Ocampo and other mining towns in the neighborhood, and are a source of great profit to the ranch owners. After we had left the Navosaigame ranch we learned that the ladies there had been educated in English-speaking schools and could speak our language almost as well as we ourselves, but they did not reveal the fact while we were trying to talk with them in broken Spanish.

The region of the Moris canyon is very broken and rough in character, and another day's journey was needed to accomplish the fifteen or eighteen miles of trail between Navosaigame and Ocampo, the southern limit of our journey, but in that distance we had to climb 3,000 feet out of the Moris canyon, descend 600 feet into the Arroyo de Rosario, and after climbing out of that ravine descend another thousand feet into a side canyon of the Candameña. This is a kind of double defile, and the mining town of Ocampo lies in the lower section in such manner that it is hidden from view until one turns a sharp corner of the trail and almost literally drops into its main street.

The town of Ocampo, formerly known as Jesus Maria, is one of the oldest mining camps of this region. It lies at the junction of two great arroyos which come together to form the head of the Candameña canyon. The houses and cabins, straggling in most picturesque fashion over the steep sides of the canyon, shelter a surprising number of inhabitants. The main street of the town is built on both sides of the bed of the torrent at the bottom of the arroyo and partakes of the usual character of the Latin American settlement: almost deserted during the hot middle of the day, but full of life during the late afternoon and the evening.

Ocampo is a little world by itself, set down in the midst of the Sierra Madre, and many grades of society were to be seen on its streets, from the well-dressed members of the families of the prosperous merchant and mine boss to the washwomen pursuing their vocation in the time-honored Mexican fashion in the stream running through the town.

We reached Ocampo at sunset on the 24th of March, and received a cordial welcome from the officers of the Balvanera Mining Company. At sunrise on the 25th we were awakened by a tremendous firing of guns and ringing of bells. The day was a great *fiesta* throughout Chihuahua to celebrate a decisive victory which General Terrazas won over the French a generation ago. For lack of cannon the hundred-gun salute consisted of firing that number of sticks of dynamite. The little plaza was gayly decorated, games were held during the day, and there was a circus performance beginning at 10 p. m., after the crowd of people who had come into town from a score of miles around had tired themselves out parading the streets and throwing confetti at one another.

The mines at Ocampo have been worked for more than a century, and have produced thousands of tons of gold and silver ore. The famous Santa Juliana mine, which is located here, holds the record as the largest producer in Chihuahua, having furnished its owners more than one hundred million dollars in bullion, according to the record of the taxes thereon paid to the Mexican government.

The sunset light glorified and beautified the bare rocky walls of the canyon below town in a way to make one forget the uncomfortable heat of the middle of the day. Two days were enough for our work in Ocampo, and noon of the third day found us with replenished supplies ready for the continuation of our journey. Now we turned northeastward, and as we climbed rapidly out of the picturesque gorge débouching at Ocampo, we paused from time to time to admire the wonderful sculpture wrought by the wind in the beds of white volcanic ash. At an elevation of 2,400 feet above the town we attained the level of the high mesa after passing one of the numerous piles of stone which dot the mountain trails of Mexico. These piles are usually situated at sudden changes of grade, either up or down, and are said to have been thrown up to warn packers of the need of adjusting the loads on their mules. Some of the piles are surmounted by one or more crosses. These are said to mark spots where travelers have lost their lives.

Five miles' ride through a dense forest of hemlock and pine, with here and there an open glade, brought us to the mining camp of Pinos Altos. The camp doubtlessly received its name from the forest surrounding it, but that forest long since disappeared into the bowels of the earth to form the timbering of a great mine. The mine, too, has seen its best days, and the town is half deserted, pending the opening up of untouched property by a new company. The region is intersected by a network of great veins of quartz which resist destruction more successfully than the soft volcanic ash, which partly surrounds

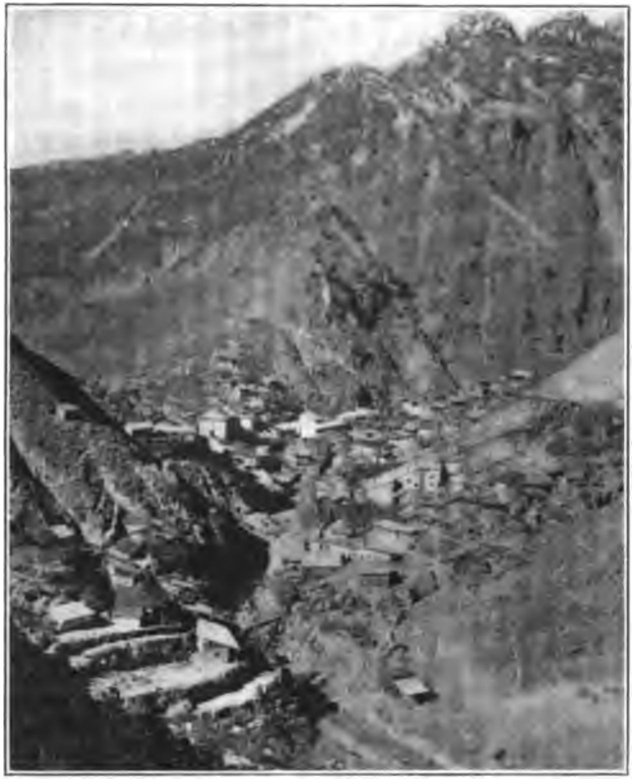

FIG. 5. Ocampo (Jesus Maria), a famous old mining town in the heart of the Western Sierra Madre of Chihuahua, Mexico.—*Photograph made for the American Museum of Natural History, March 25, 1905, by E. O. Hovey.*

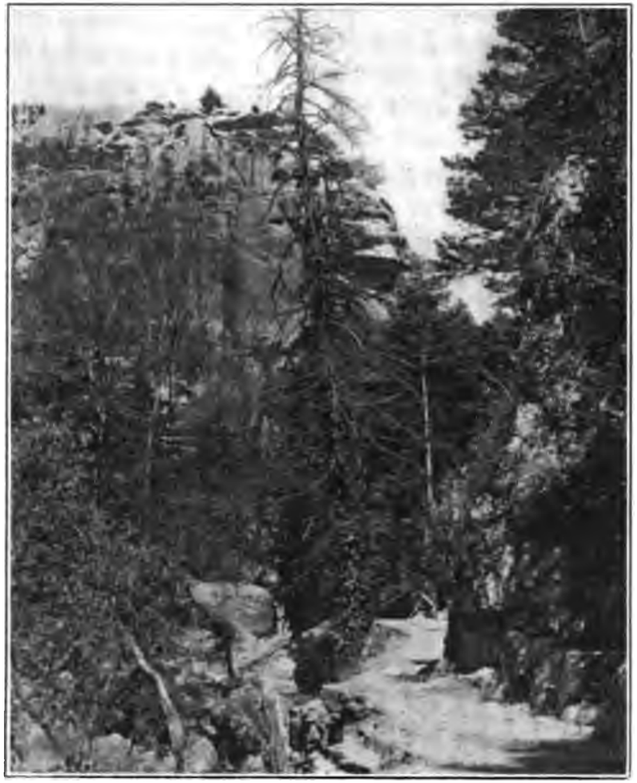

FIG. 6. In the Arroyo San Juan near Ocampo, Chihuahua, on the trail leading to Miñaca. The high, wind-sculptured cliff in the background is of volcanic (rhyolite) tuff.—*Photograph made for the American Museum of Natural History, March 27, 1905, by E. O. Hovey.*

them, and they stand out like great buttresses along the sides of the canyon of the Bravo River.

Our geologist leader had had the misfortune to fall at Cerro Boludo and break a bone in his hand. Our rude camp surgery eased his pain but little, and rheumatism, induced by exposure, added to his miseries, so that he had to be carried out of Pinos Altos on a litter borne by four Indians, leaving me behind to study the region under the guidance of a prospecting engineer whom we found there, and then hit the trail alone for the eighty or ninety miles between Pinos Altos and Miñaca. Two days after the departure of our party I left Pinos Altos early in the morning of a beautiful day and started on my lonely ride to the railroad. My guide accompanied me for an hour or more and then left me to attend to his own affairs after pointing out my trail through the forest. Unfortunately the trail was a blind one, and soon was lost on the side of the mountain. An hour's hard work, however, brought me in safety to a charcoal burner's hut in the bottom of an arroyo in the depths of the forest. The honest young peon whom I found there led me out by a short cut to the well-worn trail leading from Ocampo to Miñaca.

The day passed without further incident, the trail leading through beautiful gorges and open forests of oak or pine, according to the altitude, and past an occasional ranch. Sunset found me passing through a series of weird, narrow gorges leading down into the drainage basin of the Tomochic River, with no habitation in sight and a storm threatening. The prospect for the night was not particularly encouraging, but being without food or camp outfit I had to push on. Two hours after dark my little companion Tuck, our faithful camp dog, and I were glad enough to come to a ranch where the owner perceived the exigencies of the case and told me that I could spend the night. The immediate surroundings did not seem very promising. In one corner of the great fireplace a bed had been made up for a sick woman, over whom, in spite of her protestations, two or three little children were clambering tumultuously, and there was but one other room in the cabin. My fears were groundless, however, for after a frugal supper of frijoles, tortillas and eggs, the old farmer showed me into a new and clean log cabin in his door-yard, and pointed to a rough table made of hewn boards, as a place on which to make my bed. Perceiving that I had no outfit with me, the old man went away and returned in a few minutes with a bed quilt for my use, which I learned the next morning had been taken from the couch of the sick woman. Such is the idea of hospitality among the Mexican peasants.

During the night rain began to fall heavily, changing to snow early in the morning. Leaving La Cueva Humada, the place where we had spent the night, by 8 o'clock on the 31st of March, Tuck and I continued our march. We were still nearly fifty miles from Miñaca, and the heavy snow made rapid travel out of the question. It took us three hours to accomplish eight miles of trail and arrive at the Indian village of Tomochic, a settlement of farmers in the midst of a beautiful little valley. It was evidently impossible to reach Miñaca in such a storm, so I hunted up quarters and feed for my mule and accepted the services of the least unpromising looking *mozo* of those who came forward to help me. The chief man of the village showed me into the village school room, and there I camped for the rest of that day, and the following night, trying to dry my camera and clothing and keep Tuck warm before a little wood fire. During the night my quarters had to be shared with the mail carriers, who had a right to the school house on account of its being government property.

Saturday morning dawned bright and clear and found everything coated with eight or ten inches of snow, and a film of ice. The prospect was poor for rapid travel with a smooth-shod mule, but we started early, and when we got upon the mountains east of the Tomochic plain a scene of remarkable beauty was spread before our eyes, the pine-clad ridges being strongly outlined against the snow-covered slopes. It was now the 1st of April, and the sun was so high in the heavens that the snow did not last long even at 8,000 feet of elevation. The ride across the mesa that day was like a delightful excursion in the early springtime in New York or southern New England.

In the latter part of the afternoon the trail brought us out to the mountain pass overlooking the extensive plain in which lie the headwaters of the Aros. Shortly after sunset we entered Miñaca, the terminal town of the Chihuahua and Pacific Railroad, and were most joyously welcomed by one of our party who had stayed behind while the remainder had gone on to Chihuahua, where we joined them two days later and then proceeded to northern Sonora.

Sonora is one of the great mineral States of Mexico, copper and gold being the principal metals produced. The northern part of the State is particularly rich in the former metal. One of the great mines is at Dos Pilares, near Nacozari. Here, as elsewhere, Indians are the chief reliance for labor.

The amount of ore at Dos Pilares is enormous, but the mine, which belongs to the Moctezuma Copper Company, is chiefly interesting to visitors through its containing a vast untimbered stope, probably the largest known artificial cavity in the earth, at any rate in a metal mine. This chamber is 150 feet long, 85 feet wide and more than 200 feet high. It is estimated that 232,000 tons of ore, containing more than 18,000,000 pounds of metallic copper, have been taken from this one opening.

The ore is taken from the mine to the concentrator at Nacozari, where 600 tons of 4 per cent ore per day are reduced to 150 tons of concentrates averaging about 15 per cent of copper sulphide. These concentrates are shipped to the great smelters of Phelps, Dodge & Co., at Douglas, Ariz., for smelting with their other ores from Bisbee, Morenci and elsewhere.

Nacozari itself is a model mining town practically dependent upon the Moctezuma Copper Company for its existence. In cleanliness, order and general appearance it offers striking contrast to the average mining settlement in Mexico, or even in the United States.

Three schools are maintained here, one for Mexican boys, one for Mexican girls, and a third for the children of the officials of the company. The boys' school was a unique and interesting study in some respects. There was no semblance of scholastic dignity about the master. The day was rather cool when the writer, in company with Colonel J. H. McClintoch, of Phœnix, former major in the famous Rough Rider regiment, visited the school. We found the teacher wearing his hat and having a soiled Turkish towel around his neck for comfort, and the boys nursing their bare feet as well as they could to keep them warm. The children, however, were evidently intensely interested in the instruction which they were receiving and showed good progress especially in language work. Their penmanship was remarkably good. The teacher removed his hat out of deference to his visitors, but we saw that it went on to his head again as we were leaving the room.

Seventy miles northwest of Nacozari, in the Sierra de Antunez, is the great new copper camp of Cananea, the seat of operations of the Greene Consolidated Copper Company. Here there are enormous deposits of sulphide ores mingled with some carbonates, and the processes of mining, concentrating and smelting are carried on upon such a scale that more than 5,000,000 pounds of refined copper are produced monthly. The smelter is a dark and rather dismal sight by day, but the scene at night is one of weird fascination, with its streams of molten slag, its tremendous fiery blasts and its noisy machinery.

The mines of Mexico—copper, silver, gold and iron—are of fabulous wealth and unknown extent. Every year more and more American and other foreign capital is invading the land attracted by these and other natural resources, so that now it seems as if but a small period of time would elapse before the civilization of Mexico, now largely Spanish in character, must feel the influence of the new blood.

A Regional and Economic Geography of Pennsylvania.

PART I.

Physiography: Glaciation.

WALTER S. TOWER.

The great continental ice sheet moving down from the north into the United States during quarternary time reached far enough south to cover a part of Pennsylvania. But not over one-fifth the area of the State, lying partly in the northeast and partly in the northwest corners, was affected by ice action.

The irregular line of hills of the terminal moraine, marking the farthest advance of the ice, enters the State, from New Jersey, near Belvidere, on the Delaware, and loops first toward the west, then toward the north over Kittatinny Mountain to the top of the Pocono plateau in Monroe County (map, Fig. 1, shaded area). From there, the line, turning west again into Luzerne County, stretches away in a general northwest direction to the New York State line, north of Coudersport, in Potter County. The moraine extends across the border into Cattaraugus County, New York, where it turns sharply to the southwest, re-enters Pennsylvania in northeastern Warren County and continues still toward the southwest to the Ohio boundary near the Beaver-Lawrence County line. All the region lying to the north of this limit was covered by the ice sheet and in the different parts of its extent are many characteristic features of glacial action, modifying in varying degrees the surface forms resulting from normal processes of erosion.

The work of continental glaciers may be treated broadly under the two heads: (1) destructional action or erosion, and (2) constructural action or deposition. The first of these processes, often so marked in the States farther north, producing the rounded slopes, the *roches moutonnees* outlines, of the hills, was of relatively little importance in Pennsylvania. The absence of much ice erosion may be regarded as due to the fact that lying so near the margin of the glaciated region, the Pennsylvania areas were not subject to the long-continued advance of any great extent of ice. The ice cap was without doubt much thinner near the margin, and hence pressing less heavily on the rocks below, it was far less able to scour away the surface over which it moved. Carvel Lewis considered that the ice removed a thickness of at least seventy-five feet of sandstone from the crest of Kittatinny Mountain, but no other place in the whole area indicates erosion to a proportional extent. That there was some erosion by the ice almost everywhere, however, is shown by the smoothly-planed, often deeply-scratched and grooved, rock surfaces which appear in many parts of the area, the striations being made by the grinding of rock fragments as they were dragged along beneath or in the bottom of the ice. An occasional hill slope, especially along the northern border and in the Erie area, appears to have been slightly rounded by the movement of ice over it, but in general the sculpturing of the hills throughout the glaciated areas is essentially that of normal erosion, slightly modified by fillings of glacial waste.

The same causes which operated to prevent very much erosion by the ice at the same time favored constructional action, giving the various deposits which appear in different parts of the area. These deposits represent rock waste, boulders, gravel, sand and clay brought by the ice from regions farther to the north. For example, Professor Lewis recorded the finding of a boulder of gneiss in the moraine near Saylorsburg which, when traced to its original ledge, must have been brought at least as far as from the Adirondacks in New York, 250 miles away. The deposits of *drift* may be classed in two large divisions, according to the way in which they were made, while each class is further divided partly on the basis of origin, partly on the form of the deposit.

The first broad division includes the drift deposits made directly by the ice, either as the result of the melting of the portion in which the waste was firmly frozen, or as the result of simply being dropped when the ice sheet no longer had force enough to drag the waste along. The deposits of this class, known as *till,* are usually a heterogeneous mixture, including all sorts from clay to large boulders. The second class of deposits, though composed of glacial waste, are not made directly from the ice, but have been generally transported and more or less distinctly sorted and stratified by deposition from running water, hence the name modified or stratified drift.

Till Deposits—Terminal, Retreatal, and Ground Moraines.

The till deposits in Pennsylvania are of two sorts, the heaped-up, irregular ranges of rounded hills making the terminal and retreatal moraines, and the broad blanket of the till sheet or ground moraine, varying widely in thickness, and covering the whole general region over which the ice lay.

The course of the terminal moraine has already been traced and may be seen readily from the southern limit of the shaded area on the map of Pennsylvania (Fig. 1). Its course over the crests of Kittatinny Mountain and the high ridges to the north is some indication of the thickness of the ice-cap by which it was formed, since to allow any forward movement the thickness of the ice must have exceeded the altitude of any inequality in the surface over which it advanced. Moraine deposits, as is well known, owe their origin largely to the melting of the ice, and the liberation of waste, along its margin whenever there is a halt for any great length of time. Hence to allow the deposition of a moraine on the crest of Kittatinny Mountain, the ice cap there must have been not less than 1,500 feet thick. In regions farther north similar reasons require the supposition of an ice sheet at least a mile thick.

The terminal moraine, viewed in outline, shows the typical irregularly-placed hills, often 100 or more feet high, generally rounded and frequently connected with one another by short winding ridges. The moraine varies in different parts of its extent from a sharply defined ridge to a scarcely perceptible deposit. It is finely developed at many places, however, as in the valley of Sandy Run, near Drifton, in Luzerne County; along Shoemaker's Run and across Pine Township, in Lycoming County, and near Jackson's Run, in Warren County. Between the morainic hills are often enclosed pits or kettle holes of varying depth, occasionally holding picturesque little morainic lakes, with neither inlet nor outlet, as Minneola Lake, near Mechanicsville; Lake Poponoming, near Saylorsburg, and Deep Lake, on the Pocono plateau.

Besides the terminal moraine there are within the glaciated area similar deposits, smaller and less continuous in extent, representing temporary halts or slight readvances during the general ice retreat, hence called retreatal moraines. They vary but little in character from the terminal moraine, except that deposits of stratified drift are perhaps more commonly associated with them. Retreatal moraines appear as short ridges in many places, for example, near Lehigh Summit, on the Pocono plateau; on Nescopec Mountain, south of Glen Summit, and in Charleston Township, in Tioga County. But nowhere are these minor moraines in themselves very important features of the topography.

The ground moraine, making a blanket of drift spread out broadly over the surface, is found quite generally throughout the glaciated area. It varies in thickness from none at all on the numerous steep cliffs and ledges to a hundred or even more feet on some of the gentler slopes and in the valleys. Over most of the area the till covering would probably average much less than twenty feet thick. In the character of its composition the ground moraine is like the other till deposits; its different form is the result of the deposition of drift when the ice was no longer able to drag it along, to which has been added the deposits from the melting of the waste-filled lower layers, and from the front during steady retreat. It is chiefly from this last source that have come the great transported boulders, or erratics, often delicately balanced on the hillsides, many miles from the parent ledge. The till sheet is important not so much from its own form as from the smoothing effect it has had on the surface, especially in the Erie area, by filling the valleys and cloaking the slopes; and also in its modification of the drainage.

Obstructed Drainage.

The movement of a waste-laden ice sheet 1,500 feet thick over a region like northeastern and northwestern Pennsylvania in which there had long previously existed a well-developed drainage system, must have very completly obliterated that system while the ice occupied the region. When the retreat came the deposits left behind, filling the valleys and changing the slopes, produced many modifications in the reorganized streams. Thus everywhere in the plateau province outside the limits of the moraine, the well-organized drainage is free from lakes, swamps and waterfalls, as is generally typical of the streams in a maturely dissected plateau. Within the ice-covered areas, however, lakes, swamps and waterfalls are frequent occurrences.

The lakes appear to be of two sorts: (1) those with neither inlet nor outlet, filling kettle holes in the moraine; and (2) those resulting from the obstruction of water courses by accumulated drift deposits. Of the first class, the examples already mentioned—Lake Poponoming, Minneola Lake and Deep Lake —are the best types. Such lakes are almost everywhere characteristic of morainal deposits, being especially well illustrated in the famous "kettle" moraine of Wisconsin. They owe their origin apparently to the combination of the depressed areas of the kettle holes and the seepage of ground water through porous unconsolidated materials in the moraine.

The lakes of the second class, resulting from the obstruction of former water courses by drift fillings are far more numerous, not only in the Pennsylvania areas, but also throughout the glaciated areas of the country. Thus in Wisconsin alone there are said to be 2,000 lakes back of the moraine, and in Pennsylvania and New York the number is hardly less. The obstruction in the preglacial stream course may be either a moraine deposit, a local thickening of the till sheet, or a deposit of stratified drift—in fact any inequality sufficient to alter the drainage slopes. These deposits, acting as natural dams after the ice retreated, ponded back the redeveloping drainage until it could find an outlet over the lowest sag in the basin rim. Hence the redeveloping post-glacial streams did not always follow the pre-glacial valleys.

Lake Winola, the site of a popular resort near Tunkhannock, is a well-known example of the glacial lake resulting from obstructed drainage. The lake is separated by a low ridge of drift, about twenty-five feet high, from an old, abandoned drift-filled valley which opens toward the west into the present valley of Osterhout's Creek. The outlet of the lake is toward the south, however, a small stream flowing with a gentle fall through drift deposits, until with a series of cascades over rock outcrops, it empties into Buttermilk Creek, near Mill City. The depression which the lake occupies appears to have been a pre-glacial valley, eroded and occupied by a stream then flowing into Osterhout's Creek. Across this valley was deposited the dam of drift, the valley drainage was ponded, raising a lake to the level of the lowest sag, which happened to be toward the south into the valley of Buttermilk Creek. The cascades near the mouth of the outlet are simply the result of its tumbling over the rock walls of the preglacial Buttermilk Valley. All the natural lakes in the State, outside the morainic lakes, are of similar origin—obstructed preglacial valleys from which the ponded waters in post-glacial time have found outlets, sometimes through the old, sometimes through new, channels.

The swamps which occur abundantly throughout the glaciated district, especially in the Pocono region and in the Erie area, are either imperfectly formed, or nearly drained, lakes. In the first case the cause would be the presence of a drift barrier too low to completely obstruct the reorganized drainage. In the other case the lowering of a drift barrier by post-glacial erosion would result in the conversion of a former lake into a swamp. These swamps are so extensive on the Pocono plateau that the region has always been one of the wildest parts of the State: "a wilderness of forest and swamp."

The rearrangement of river courses made necessary by drift obstructions in the pre-glacial valleys, has resulted in many cases in the diversion of the streams to new channels, as in the outlet of Lake Winola, in which falls and rapids occur. These features are illustrated in the Pocono region better than in any other part of the State. In the hard, horizontal strata of the plateau the pre-glacial streams had cut many steep-sided ravines which were more or less filled and obstructed by drift deposits. The reorganized post-glacial streams, adjusting their courses to the new slopes of the drift-covered surface, often enter these old ravines over the edge of the valley wall, or flow down the face of the plateau escarpment in a series of picturesque cascades. The falls of the Sawkill, near Milford; of Raymond's Kill, or Ramyskill, of Dingman's Creek, of the Big Bushkill and of Paupack Creek, tributaries of the Delaware in northeastern Pennsylvania, are all typical examples of the effects of glacial disorganization of drainage. Dingman's Creek has three cascades of about ten, twenty and one hundred feet, and Paupack Creek, near Wilsonville, has a fall of 145 feet in 100 yards, both of these localities ranking among the most picturesque spots in Pennsylvania.

Filled Valleys.

Drift deposits in preglacial valleys, however, are found in many places giving merely broad valley bottoms without any evidence of lakes, falls or rapids. Tioga and Cowanesque Rivers, French and Shenango Creeks, and in fact nearly all the streams in the Erie area, flow over broad, flat valley floors, resembling well-opened-out flood plains, from which rise abrupt valley walls several hundred feet high. Well borings show the presence of drift, both till and stratified drift, often to depths of 100, 200 or more feet, while the present streams flowing over the surface of the drift are entirely too small either to have eroded the valleys or to have made the deposits. These heavy drift fillings are apparently due partly to the lodging in the valleys and the subsequent melting of the lower waste-filled layers of the ice cap, and partly to the depositions by over-loaded or ponded streams flowing in, beneath, or outside the ice. These two processes associated in the valley filling easily explain the inclusion of both stratified and unstratified deposits in the same section. Along the sides of these filled valleys deposits of similar composition frequently appear as distinct terraces, well shown round about Tioga, where they were apparently formed between the valley sides and a tongue or block of ice which still lay over the valley floor.

The most striking example of the filled valley is found along the North Branch of the Susquehanna from Pittston to Nanticoke. Well-borings have shown the presence of loose glacial deposits, fine mud and "quicksands," extending, near Forty Fort, to a maximum depth of 185 feet below the present river level. In the drill records the rock surface at the bottom is said to have shown undoubted signs of water scouring, while different borings indicate that the cross section and side walls of the filled trench closely resemble a normal river-developed valley. It has been suggested that the great depth of the trench is due to the powerful scouring action of heavily-laden, flooded, subglacial streams at work on the soft strata of the coal measures. There are serious objections to this theory however, in spite of its apparent plausibility. First the character of only a small portion of the trench has been revealed by the well records, and, second, the depth of the filling at Forty Fort extends seventy feet below the level of the lowest known outlet of the region.

Valley filling of this character, though not giving lakes and falls, has often brought about a change of drainage divides, as a result of which the postglacial streams do not always follow the preglacial course. For example, between Clarksville and Shenango in Mercer County, the well-marked drift-filled valley followed by the Erie and Pittsburgh Railroad, is apparently an old valley eroded by Shenango River, but now abandoned for the long course making "Big

Bend." In some of the buried valleys two streams now flow in opposite directions from a common divide, often so low as to be imperceptible to the eye. Mill Creek, flowing north to Meadville, and Mud Run, flowing south into Little Sugar Creek, head in a swamp which feeds both streams. Little Sugar Creek heads up to an imperceptible divide from which another stream flows north into Woodcock Creek. And French Creek —south branch—and Oil Creek head together between Corry and Spartansburg in a ***throughcut*** valley with walls 100 to 300 feet high.

Terraces.

Somewhat analogous to the filled and terraced valleys of the glaciated area are the extra-glacial walls with terraces of sands and clays. These terraces are distinctly stratified river-laid deposits—mere remnants of once extensive valley fillings. The filling of the valleys in front of the moraine has been due in some cases to the overloading of south-flowing streams while the ice still lay over the northern area; and in other cases it has been due to the obstruction of north-flowing streams by ice dams. Either case favors aggradation in a river supplied with very much waste. Later conditions, however, have allowed the streams to scour out their valleys again, leaving traces of the former deposits only where protected on the inner sides of bends or by ledges projecting from the valley wall.

Extra-glacial deposits of the first class are found along the Delaware, Lehigh and Susquehanna for many miles south of the moraine. Along the Schuylkill, however, they are absent, since none of its headwaters lay in the ice-covered region. The high level terraces and abandoned river channels along the rivers of the western plateau are believed to be due to the formation of ice dams during the glacial epoch. Some of the best examples of terraces are found along the Ohio and Beaver Rivers, near the junction of the two streams. New Brighton was built on a series of three terraces at elevations of 30, 80 and 125 feet above the river. Along the Ohio four terraces appear, in different places, at elevations of about 40, 60, 90 and 120 feet above the river, many of the small towns being located on these benches.

Finger Lakes.

As the ice sheet advanced into the State from the northeast it obstructed the courses of the north-flowing streams, like Tioga River and its tributaries. The waters were thereby ponded back between the ice front and the divides to the south, and the valleys were converted into a series of long, narrow finger lakes, like the great finger lakes—Seneca, Cayuga, Oneida—of New York State. The level of the water in these branching lakes continued to rise until it reached the lowest sag in the divide. For the Tioga system the lowest point was apparently near Ansonia, and it served as an outlet or spillway through which all the lakes filling the valleys of Cowanesque and Tioga Rivers, Crooked Creek and the smaller tributaries probably drained for a time. But as the ice advanced beyond Lawrenceville the Cowanesque Valley was isolated and the lake had to rise to a new outlet, at first evidently over the divide west of Little Marsh, between the headwaters of Jemason and Crooked Creeks. Later, when that outlet was ice-covered, the lake emptied over the higher divide southwest of Sabinsville between the headwaters of Mill Creek and Long Run. These lakes, gradually shortened by the encroaching ice, continued to lower their outlets until the ice advance reached the crest of the divide and the lakes ceased to exist. The lakes appeared again, however, as soon as the north slopes of the divide were uncovered by the retreating front, and persisted until the northward drainage could be reestablished.

As soon as the northern outlets were uncovered most of the spillways across the divide ceased to act as stream courses, and now appear only as low, often wide, passes. The spillway near Ansonia was the single exception. Before the ice advance, a winding valley had been eroded between Ansonia and Tioga by a large north-flowing stream tributary to Tioga River. The Ansonia spillway, however, was lowered far enough during glacial times so that, combined with the filling of the old preglacial valley, it resulted in the reorganized drainage following a southerly course into Pine Creek. In other words, glaciation brought about a direct reversal of a part of the drainage. At present, therefore, the preglacial valley is occupied by two streams, one turning south to Pine Creek, the other north to join Tioga River. Neither of these present-day streams had anything to do with eroding the valley in which they flow. A part of the valley nearly three miles long, flat and marshy, is unoccupied by any stream. It seems very probable that a similar chain of events has marked the development of other through-cut valleys in the western part of the glaciated area.

Kames, Eskers, etc.

Various deposits of modified drift in rounded conical hills or long, narrow ridges, kames and eskers, occur in different parts of the area, usually as deposits from streams probably flowing in or beneath the ice sheet. In the States to the north these various forms of stratified deposits often appear among the prominent surface features. In the Pennsylvania areas, however, they are but little developed, and are relatively unimportant except where, as local thickenings of the drift, they have helped in the formation of lakes.

Ceylon—A Tropical Island.

LAURA BELL.

The theory advanced by many that man is by nature an unsocial being must needs be proven before it can be generally accepted, for the universal habit seems to have been from earliest times to draw people together in a common settlement. Down through the ages this has been more and more evinced by the increasing multiplicity of overcrowded towns and villages, and the growing difficulty to find any place sufficiently secluded as to admit of a man following out any unsocial tendency, or to indulge in that rest and quietude which can only be obtained at a distance from train or trolley. It would seem at first glance that such a spot could best be found on an island, and the theorists above alluded to may well make this their strong point, for who, at some period of his existence, has not longed for the circumscribed boundary of an isle of the sea, where he could reign supreme and care not what went on beyond? He thinks he would never tire of such territory and authority, and yet an instinctive restlessness, the innate desire for knowledge, prompts him to extend his experiences, and lo, the theory is shattered, for knowledge involves contact with outsiders, and man must indeed be social to understand and enjoy his birthright. Granting, however, that every one bears a peculiar feeling toward an island, a feeling verging toward romance and tenderness, let us glance for a little at an island paradise situated in the Indian Ocean and consider what it is that makes Ceylon one of the most attractive spots in all the world.

Geographically considered, Ceylon lies six degrees above the equator, and is a cone-shaped island, separated at its narrowest point from the southeastern coast of India by the Gulf of Manaar, and ledges of rocks, to which the name of Adam's Bridge has been given, nearly connect it with the main land. Whether it ever did form part of India has been disputed by writers from the fact that certain animals, insects and reptiles have been found here which were unknown on the adjacent continent. It has a varied coast line, sandy to the north, precipitous on the east, and thickly wooded on the south and west. The interior has mountains between seven and eight thousand feet high, Adam's Peak being the most noted. It is annually ascended by throngs of pilgrims, being held in veneration alike by the Hindu, Buddhist and Mohammedan, as the miraculous footprint in the rock is variously ascribed to Siva, Buddha or Adam, one legend being that Adam and Eve took refuge in Ceylon after their expulsion from the Garden of Eden. The view from Adam's Peak is also enjoyed by adventurous tourists who are not averse to essay a difficult and laborious ascent, though they do not always reach the top.

The first sight of a tropical country is one never to be forgotten, and equally distinctive is the first smell of this particular land, for spicy odors are wafted through the mist long before any outline of the coast becomes visible. A steady downpour of rain decides the experienced traveler to wait some hours before disembarking in a small open boat manned by Singhalese rowers, so that he and his impressions may not be dampened and that he may enjoy to the full his new surroundings. The fine breakwater at once claims his attention, now making Colombo the chief port of Ceylon since its construction, and forms a necessary protection from the dashing combers raised by the strong monsoon. The Custom House greeting being duly paid, a drive through the streets and out along the red road by the beach, passing en route queer two-wheeled carts with matted covers, drawn by patient bullocks, brings him a mile or so beyond to the Galle Face Hotel, with tall, crooked cocoanut palms, which always thrive best near salt water, growing in picturesque groups beside it. The long chairs of the Far East on the veranda are filled with men drinking and smoking in idle ease and the corridors by the sleeping apartments are lined with equally idle servants lying on the floor awaiting their masters' commands.

The rooms are simply furnished with regard to coolness and cleanliness, no drapery of any kind save mosquito netting over the beds, and a carefully itemized list of every article of furniture contained in the room, casts an ominous doubt on the reputation of its former occupants. Being assured that the *almirah* is still there, for this wardrobe is the only thing that has a lock, one is immediately warned by residents of Colombo never to leave anything of value outside of the trunks, for whatever the natives do not steal the crows do, and many a ring or collar stud inadvertently left on the dressing table, a thimble, pair of scissors, or any silver toilet article, quickly disappears and is not likely to be traced. Truly, the crows sometimes are the real thieves, as they impudently fly in and out of the windows with a strident caw and pick up a piece of toast from the early tea or *chota hazrai*, served on awakening, before one has time to break off a morsel for himself. There had just been quite a stir when a wealthy American woman discovered that a little basket, in which she had placed all her jewelry preparatory to packing it, had mysteriously vanished from sight. Reporting the loss at the office, she was rejoiced a few hours later by the recovery of her jewels. A crow had swooped off with them when her back was turned, and carrying the basket in its beak to the top of a palm tree, shook out the contents, raining down bracelets and brooches on the head of a sleepy little Tamil boy beneath, who picked up the glittering objects, and being honest, brought everything into the hotel, saying he thought he ought to have a pound for doing so. Needless to say he was given it at once.

The European part of the town is very different from the native quarter, and the latter is by far the most interesting with its heterogeneous population. The newcomer is at first bewildered by the different races encountered on the roads, types with which he is unfamiliar, but he soon learns to discriminate between the native Singhalese, the low caste Tamils from India, the Mohammedans, or Moormen, as they are called here, and the Burghers or Dutch Eurasians, all shades of color being seen, from palest yellow through copper hue and bronze to deepest black. The humid, steamy atmosphere of Colombo does not favor much exertion, and, indeed, why should any inhabitant of a tropical island ever exert himself? Nature is rich and bountiful, and if one has a shelter large enough to sleep under, made of braided palm leaves, supported by bamboo poles, the plantain and cocoanut trees growing beside it conveniently drop provision without the necessity of toiling for one's daily food. Clothing, too, is only a vexation and encumbrance, so thin cotton cloth is worn in scanty quantity. The Singhalese are spare and erect, and have long, sleek black hair, worn in a coil at the back of the neck, and the top of the head is adorned with a semi-circular yellow tortoise shell comb worn like a crown, with the two ends pointing over the forehead. The Singhalese woman wears her hair in quite an elaborate fashion, without the comb, and ornamented with long brass or silver pins, but goes to the extreme in rings. Nose rings are most disfiguring and earrings are inserted all around the top and side as well as in the lower part of the ear. The woman from the Occident rarely again allows the diamond or the pearl to dangle from her pretty ear after having seen this uncivilized fashion so appallingly prevalent in the Far East.

Another offensive custom spreading in the Occident, that of chewing gum, is practiced by many Orientals in chewing betel. Betel, made from the nut of the areca palm mixed with a sort of lime from coral, can be bought very cheaply done up in the small leaf packages the length of a finger. The whole thing is put in the mouth at once and chewed constantly, staining the teeth and giving the impression that the person is suffering from a long-continued hemorrhage, until informed that sympathy is unnecessary, as it is not blood that trickles down the chin and bespatters the roads. Leaves serve many purposes, and one of the delights in shopping in tropical markets is to have the purchases of fruit wrapped up in nothing but leaves, which are arranged in fresh assorted sizes to be used as wrapping paper, a veritable relief from paper bags and pasteboard boxes.

In character the Singhalese are shrewd and revengeful, and if the master is disliked by the servant for any slight reason, such as by being late to dinner often, as in one case cited, the servant coolly procures poison, tries its effect first on the dog, and later on the master himself. Servants always go in bare feet in presence of their superiors, and when thus served for the first time by waiters in a hotel dining-room the novelty is peculiar, but the absence of noise is most satisfactory.

The temples are interesting to visit, and adjoining one in the neighborhood of Colombo is a fine library containing rare volumes illuminated with bizarre pictures, the elephant being frequently seen on the pages. Some of the manuscript books are written in exceedingly clear and distinct characters on leaves of the talipot palm and the covers are often of open-work silver. The walls of some of the temples are decorated with curious paintings, showing the different heavens or hells to which the departed are sent according to their lives. One smiling figure reclining stifly on a stiffer uncomfortable-looking yellow sofa, represents the happy state to be enjoyed when obedient to one's parents, and various tortures and torments are portrayed as the fate of the evil-doer. One of the most celebrated temples is at Kandy, where is enshined the tooth of Buddha. This sacred relic is shown only at rare intervals to the believer and is annually paraded about the town, carefully guarded. But the scoffer, for a money consideration, can sometimes induce the yellow-robed priests to give him a glimpse of this long molar, which closely resembles an alligator's tooth, and is kept in a glass case in the darkest part of the temple, dimly lighted for the few seconds one is allowed to look at it and pass on. Services are constantly conducted in the temples, accompanied by loud beating of drums and noisy cries from the priests. The air is heavy with the perfume of flowers, which are for sale at the entrance and are bought by every worshiper, who strews the blossoms about the floor and altar. The old bo-tree in the vicinity is as much an object of worship as the tooth, and its leaves are eagerly gathered from the ground, though never plucked, to be carried home by the devout pilgrims. This is one of the oldest trees on the island,

and is vouched for as having lived for over two thousand years, though not even the most credulous can prove the statement.

Kandy is beautifully situated in a green amphitheater among hills, and an artificial lake about three miles in circumference, banked in with a low stone wall, adds greatly to its attraction, affording a pleasant promenade and drive around it. These lakes or tanks, as they are usually called in Ceylon and India, are near the temples and must have involved great labor in their construction. They were built during the reigns of the early kings of Kandy, and anyone who is fortunate enough to evade attention and to commit suicide in one of these holy tanks is a lucky being. The ride in the train from Colombo up to Kandy shows many kinds of growth unfamiliar to one not accustomed to tropical vegetation. Groves of bananas and palms, rice fields and tea plantations are spread before one, and the native huts nestling in the thickets are only exceeded in picturesqueness by the natives themselves as the sun touches their bronze figures; the pet monkeys chatter with the children and bright-hued birds take wing and fly away; a dreamy languor steals over one, perchance caused by the overpowering fragrance of the flowers, and the fascination of the tropics has entered one's veins. The railway ascends gradually in zigzag fashion, and the views become more extended, ever changing from deep abyss to steep acclivity, and mountains raising their heads afar give promise of a cooler atmosphere than the perennial steaming heat of Colombo. The promise though is not fulfilled at Kandy, and it is only on reaching Nuwara Eliya, a journey of some hours beyond, that the health-giving breeze and a more normal temperature can be encountered, and where a tiny fire in the grate of the hotel drawing-room at nightfall makes glad the heart of the average Englishman.

In the Cinnamon Gardens at Colombo may be seen vines and trees idigenous to this country, as well as foreign plants, but a special visit should be made to the far-famed botanical garden at Peradeniya, a few miles from Kandy, where there is a fine collection of all tropical growths. A nursery garden in the higher ground at Nuwara Eliya also contains many unusual specimens of plant life. Trees with long, snake-like roots exposed, nutmegs, mangoes, cinnamon and acacia are a few of the many interesting groups, and ferns galore and aquatic plants delight the eye. In one portion of the garden in Peradeniya is a favorite resort of the flying foxes, a kind of bat, which hang suspended by their claws from the india-rubber trees, resembling brown bags swaying lightly to and fro, for in the day-time their furry, fox-like heads are nearly concealed in their wings, which are folded together like a clumsily-rolled umbrella. When flying, their wings extend about three feet, but their bodies appear to be not more than a foot long. The trees with these curiously burdened branches are sure to be quickly noted by the observant traveler. The traveler is not long in an island where the fan-shaped palm grows before he employs an agile native to clamber up monkey-like and with his knife cut the stalk at the exact juncture where the water can spout in a full, cool stream to fill the glass held beneath, and his first draught of water from the traveler's palm is as refreshing as though he were perishing from thirst on a march through the desert.

The insect life is the most active one in the tropics, and at night the air is vibrant with the hum of many noises emitted by myriads of their kind. One of abnormally loud voice is appropriately called the anvil, and no closer imitation could be given of the loud, metallic stroke made by the sturdiest smith extant. It is not very conducive to sleep until one grows accustomed to the regular intervals between the sounds and no longer lies awake to listen for its repetition. One of the cicada family earns the name of the knife-grinder, as from the sound produced it seems to be performing that whirring task. Fireflies make the night luminous, and the heavy air hangs a curtain of mystery over the tropical scene. Two of the most interesting insects are brought by the natives to show to the traveler in daylight, the stick insect and the leaf insect, the former with its thin body and six legs resembling a twig shorn of its leaves, and the leaf insect, when not in motion, can only be detected by the closest scrutiny, so perfect is the imitation of a leaf in color and shape, for even the legs are expanded like half-opened leaves. The invasion of the ant, particularly of the white ant, is much to be dreaded in all tropical countries, and is only to be resisted by the hardest of wood, such as teak. Tin boxes are much better for travelers' purposes than the ordinary wooden trunks. The industrious little creatures often undermine houses, and the position of articles of furniture has to be frequently changed and constant watch kept of the operations of the ant colony, which is so destructive.

From the ant to the elephant is a long step, but one easily taken in the tropics, and a daily drive can be made from Kandy to the stream where the elephants are washed. The mahouts scrub them with the husk of a cocoanut, and the huge creatures play with the water while three or four natives act as valets and superintend the bath of his highness. The elephants of Ceylon have small, short tusks, and seem never to grow to such great size as in India and Africa. They are trained to do practical work, and in Burma it is interesting to see how their strength is utilized in moving great pieces of timber and piling it up, which they do slowly and intelligently, under the guidance of the mahout. As to reptiles, the writer was fortunate in not seeing any live ones, except those in the baskets of the snake-charmers, although one experience might have been exceedingly unpleasant. When attending an evening service in the church at Kandy, as the congregation arose at the conclusion of the sermon, a venomous snake, three feet long, was discovered coiled up among the prayer-books on the shelf at the back of one of the seats, and being aroused by the people dispersing, it escaped to the ground. Despite the darkness, however, it was soon killed, but there were some uncomfortable shudders at the thought of what might have occurred, and the reminder came that the serpent is sure to be found even in an island paradise. It certainly looked very snaky in the tangled jungle on all sides approaching Nuwara Eliya, and the very wild flowers in vivid purple and yellowish red had an unwholesome blotchy appearance suggestive of reptiles, and the sniff of the heavy air, the indescribable atmosphere of the jungle was sickening and unrefreshing. But as the toy train clambered up the side of the mountain in long curves, the pure air of the clearing was revivifying.

After leaving the regular line the journey to the top was continued in a very narrow-gauge train, which was making its initial trip. The railway had just been completed, and the small engine was decorated with flags, and bore two engineers and two officers of the road as well, who towered above the engine as they stood on the ledge outside the cab. The four passengers in each box-like compartment had not many spare inches between their heads and the top of the carriage, and the body of the cars was raised only about a foot above the ground. Formerly, on leaving the regular gauge train, the drive over the pass was the only means of reaching the hotels and cottages on the hills, and returning by that route, other fine views of the surrounding country were obtained. On the walls of the hotel were hung pictures of this newly-built railway and of all the other crooked railways in the world, that of Mt. Tamalpais in California vieing with the one from Calcutta up to Darjeeling as being the most crooked, although possibly some others which would not wish to be so advertised might be found to be equally crooked.

Ceylon is rich in ruins, and the buried cities, notably that of Anuradhapura, are full of interest to the archæologist, but almost too inaccessible for the ordinary tourist, although a visit to Anuradhapura, the most ancient capital of Ceylon, is always recommended. It is said that its gigantic dagobas inside the ruined temples rival the pyramids in their dimensions, but the architecture of a dagoba is not beautiful, the pagodas of Burma being much more graceful in shape and more picturesque. In gems also the island has a continual source of wealth, but the natives are such skilful cheats and are so quick and tricky in substituting glass for the real stones that one would have to rely upon the judgment of an expert before investing heavily in these tempting jewels.

In summing up the varied attractions of the island it must be borne in mind that this is but a cursory description of what has seemed novel and interesting to one unused to tropical sights, and therefore gave pleasure on first acquaintance. Whether a continued residence amid such surroundings would pall is left to conjecture. After a last meal at Colombo, with many kinds of curry and those curious roasted cashew or cadju nuts, which bear the suggestive name of coffin nails in the vernacular, for a digester, the jinriksha coolie is in readiness to trot cheerfully off to the waiting steamer, the catamarans dart over the waves like gulls, small boys dive on all sides to bring up in their mouths the coins flung overboard by the departing tourist, the whistle blows, the teeming earth of Ceylon fades from sight, and the saunterer, the man "*sans terre,*" many a time and oft dreams again of the charms of a tropical island.

A Norwegian Landslip.

ALBERT PERRY BRIGHAM.

The catastrophe which is here described occurred at eleven o'clock on Sunday evening, January 15, 1905. It is noteworthy not for its physical magnitude, but for its peculiar character and tragic loss of human life.

Nord Fjord penetrates the mountains of western Norway for a distance of about fifty miles, and the hamlet Loen is at its head. Continuing the fjord valley are several tributary valleys radially disposed, the larger of them containing lakes,—Olden, Loen and Stryn,—at distances of two and one-half, five and eleven kilometers, respectively, from the fjord waters. Lake Loen occupies the medial position and extends to the southeast. The scenery of this group of lakes is among the boldest in Norway, for the great plateau and its summits rise by sheer precipices and steep slopes to heights of five and six thousand feet. Back of the lake region is the Jostedals Brä, the greatest of Norwegian icefields, and tongues of this glacier sheet extend northwestward on the heights between the lakes and project icefalls and hanging glaciers upon the declivities that overhang the waters.

The road from Loen to Loenvand leads up over moraine topography by the side of the outlet torrent, and among fields which for Norway are luxuriant with grass, vegetables and grain. The outlet is across a sill of rock, flanked by high rocky shoulders which rise into the bordering cliffs in such fashion as to demonstrate that the lake waters occupy a rock basin. The water surface is 88 meters above the level of the

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[1] This paper was read before the Association of American Geographers at its meeting in New York, December, 1905, and a brief abstract was published in the BULLETIN of the American Geographical Society for February, 1906.

fjord, and the lake is 133 meters deep. Its deepest part is, therefore, 45 meters below sea level. All these features characterize many other Norwegian lakes—their position near the head of the fjords, separation from the fjords by tracts of glacial moraine or terrace, considerable altitude of surface, and bottoms below sea level. Not all lie so demonstrably in rock basins. Loen is 11.5 kilometers long and averages about one kilometer in width. Glaciers peep over the crests or descend into well-made cirques, while a journey of about five kilometers from the head of the lake brings one to the stupendous icefall of Kjendal glacier. The path thither leads along the continuation of the Loen Valley, over a train of waste deposited by the glacial stream.

The writer's visit to Loen was made on July 24, 1905, or a little more than six months after the catastrophe. The knowledge of the event came as a surprise, and there was no opportunity to prolong the visit or study in detail the conditions of the landslip. A day's climb where the mountain was scarred by the fall would have been particularly desirable. Aside from personal observation, information was gathered from Captain Oxaas of the steamship Vega, from the master of the small steamboat which plies the lake, and from the Bergens Tidende of January 17, 1905, a copy of which was secured upon returning to Bergen. The master of Lodölen, the small boat to which reference is made, has his home upon one of the devastated lowlands and is one of the few, if not the only, competent surviving witness of the event. Being awakened out of sleep, he saw but in part and dimly in the confusion and darkness of the night.

The conditions of the slip will be best understood by reference to the map. The place is the west shore of the lake, a little more than two kilometers from its head, or north of Nasdal. Opposite from this point a slow spur 30 to 40 meters in altitude juts into the lake. It is bed rock, with soil enough for meadow, and precipitous sides bordering the lake, which is perhaps not more than a half kilometer wide between this spur and the opposite point where the fallen mass entered the water. North of the spur is the village of Bödal, occupying the mouth of a valley whose floor is not much above the lake. Näsdal is on a delta, which is very flat and lies barely above the ordinary level of the lake. These fields, according to one of the writers in the Bergens Tidende, are often flooded. The delta is built of the waste delivered by two streams. One is the torrent in Kvandal, entering by a gorge or hanging valley that is cut to within a few hundred feet of the lake level, and the other falling in long reaches 4,000 feet from its cirque and glacier far up the mountain. On the delta, as at Bödal across the lake, was a small group of farm houses, with their attendant structures, and here a few dozen men, women and children found conditions of living quite ample for Norway, and went to their rest on the fateful Sunday night all unconscious of the impending disaster.

At the point where the fall occurred a remarkably steep talus rises to a height of 2,000 or 2,500 feet. It appears to have been a thin veneer of waste over bed rock, and the same conditions are now doubtless to be found both north and south of the scar, where much of the ground is covered by shrubs and low forest growth. The width of the slope affected cannot be more than a few hundred feet. The beginnings of the catastrophe had no witness, but no doubt the loosening of the mass and its descent were little other than instantaneous. We cannot know how nearly the plain captain of the little ship Lodölen hit the truth when he said that it was all over in two minutes.

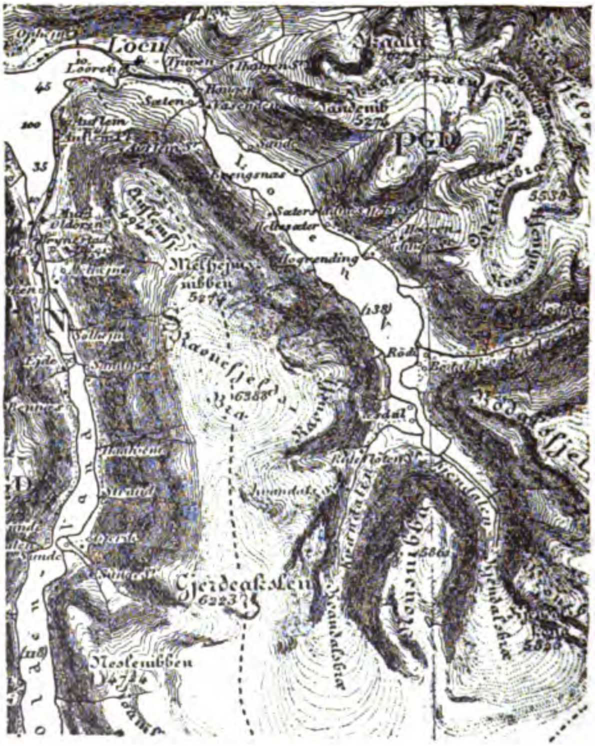
The avalanche of earth and rock entered the water and raised a wave which swept the entire lake. Nowhere on the shores of Loen does this wave seem to have been less than six meters high. It rolled up across the delta grounds of Näsdal and did its work of ruin there. Simultaneously it swept past the opposing spur and inundated Bödal, leaving its trail of dead bodies and debris of homes. Houses, people, domestic animals, utensils and implements of every kind were involved in the common destruction. Boats were crushed and every boat-house on the lake was swept away. The flood torrent ran two to three meters along the outlet stream that flows down to the fjord. Possibly some suddenly aroused victim may have realized the vivid description of the "Tidende" writer—"The sound must have been terrific, and even though the people are accustomed to the noise and crash of mountain and ice-falls, this must have seemed like the crack of doom."

The steamboat Lodölen was moored across the lake from the slip. The height of the wave was not there limited to six meters, for the boat was found 40 meters above the lake and several hundred feet inland on the jutting spur already described. The machinery was taken out and placed in the boat that now goes up and down Loen, but the hull lies where it was deposited, and its captain, learning of the writer's interest, was good enough to land the new Lodölen at Bödal, giving opportunity to walk over its ruins and to make the short run necessary to see and photograph the stranded craft. The old boat was 48 feet long.

The first reports gave the loss of life as 59. Later knowledge made it certain that 61 persons perished—34 in Näsdal and 27 in Bödal. A diver from Bergen made such search as was possible, but only nine bodies were recovered. A boy five years of age was found at one of the settlements, the only survivor of his family.

The massive slabs of rock often built into the foundations of the substantial Norwegian farmer homes were thrown about as if of wood. The steep shores of the projecting spur were denuded of soil and trees, and it was stated to the writer that the water entered by the descending mass had been 30 fathoms deep, but was reduced to 20 fathoms. No doubt more trustworthy data may later be had from Norwegian accounts of the event. The shallowing was said to extend but a little way from the shore.

As has been indicated, the exact conditions which led to the slip could not be properly studied without more time than was at command. The appearance of the cliff above the talus slope indicated that the cleavage there is approximately vertical. There can be little doubt that freezing water, perhaps for a succession of years, gave the thrust which finally caused the downfall. The impact of the falling mass as it struck the top of the talus seems to have cleaned the sheet of talus material from the steeply inclined rock surface that lay beneath, all descending with increasing momentum into the waters. The cleavage under the talus appeared to coincide in direction with the slope of the talus, changing thus from its attitude in the cliffs above. If this observation was not deceptive, it helps to explain the swiftness and power of the movement, as over a rock floor made smooth for the slide. Perhaps the cause could not be better stated than by a single sentence from the account in the Bergens Tidende: "On the steep mountain sides the water is confined in narrow crevices, and in winter turns into ice, and little by little thrusts the mountain to pieces, until great masses are completely undermined."



Map of Loen and Vicinity.

Book Reviews.

Atkinson, Fred W. *The Philippine Islands.* Pp. 426. Ginn & Co., Boston, 1905.

Abundant as has been the crop of magazine articles and even more formal treatises on the Philippine Islands since the war with Spain, yet there seems to be a lack of precise information which is surprising. This lack of information the author of this book supplies in a very readable manner. He discusses the general geography of the islands, their history before the insurrection of 1896 and after the American occupation. The influence of climate on the civilization of the islands is considered in some detail, and the excellent work done by the Jesuits in the study of climate and earthquakes is praised. It seems that the director of the Manila Observatory was the first person in the Orient to predict the existence, duration and course of the violent storms, known in the China Sea by the name of typhoons, and in the Philippines by that of baguios. To complete his interesting resumé of conditions in the islands, the author in as many chapters considers the public health, commercial geography, city of Manila, Philippine people (dividing them into Christian and non-Christian), religion and superstitions, while in the final chapter he considers the system of government and education before and since the American provincial government undertook to give to the several diverse tribes an autonomous local government and system of education.

Numerous reproduced photographs and several maps embellish a book bound in attractive red binding.

John W. Harshberger.

University of Pennsylvania.

Barnes, Anna M. *An American Girl in Korea.* The Penn Publishing Company, Philadelphia, 1905.

Korea—"the chosen spot of the earth for the chosen people"—"the pearl of the earth"—is attractively portrayed by Miss Barnes. This work is pronouncedly juvenile in character, being the adventurous journey of an American missionary with his family of young people up the Han River in a native river boat or "sanpan," manned by native polemen, and ballasted with native money. The chief value of the book lies in its power to interest the young reader in the natural features of Korea and in the habits and characteristics of its people in the very palatable form of a thrilling tale.

Rachael P. Barker.

Lippincott's Gazetteer of the World. Edited by Angelo Heilprin and Louis Heilprin. Pp. x, 2053. Philadelphia, 1906.

As the title page reads, this work is "a complete pronouncing gazetteer or geographical dictionary of the world, containing the most recent and authentic information respecting the countries, cities, towns, resorts, islands, rivers, mountains, seas, lakes, etc., in every portion of the globe." The book itself, though appearing under a name now almost a half century old, is essentially a new work, as will appear at once in a comparison with any of the earlier editions of Lippincott's Gazetteer. To quote the publishers's note, "it presents a picture of the world in its minutest details in the year 1905."

A good example of the up-to-date character of the information is found in a part of the entry under the heading Port Arthur. It reads: "It was, however, forced to surrender to the Japanese on January 1, 1905, who retain it conformably to the terms of the treaty of Portsmouth (September 5, 1905)." The opening of the so-called Hippodrome in New York in 1905 is also included, but the completion of the important tunnel connecting Boston and East Boston failed to be recorded. It is manifestly impossible, however, to record everything that happens during the preparation and printing of a book of this size and scope.

Under the heading of each country there is a discussion generally proportionate to its importance. These discussions, as, for example, in the case of France, comprise a sketch of the relief of the land; the principal rivers and lakes, with their commercial importance; the climate; products, agricultural and mineral; manufactures and transportation; government; religion; educational system; army and navy; colonies and dependencies; population and a short historical sketch. Under all these headings, naturally enough, the consideration of available space has necessitated an exclusion of all but the salient, useful and important items of information. The editors have been the judges of what should be included, and they seem to have chosen wisely as a rule.

The same general formula has been followed in the case of the smaller political divisions, as States and provinces, especially in the different States of the United States, where each one is for most purposes almost as satisfactorily discussed as in a many-volumed encyclopedia. In the case of cities, towns and villages, the method of treatment varies from a mere definition of location and size to a thorough exposition as long as that of many a State. The inclusion of settlements in the United States is carried out much more completely than in the case of foreign countries, extending to practically every group of houses large enough to boast a name, to post-villages of 100 inhabitants, and even to mere wayside stations on the railways. Any reader may prove this fact for himself by looking up the names of such places with which he is familiar.

The ordinary reader will, however, be very quickly struck by the apparent lack of proportion as regards space given to various places. Thus the quiet little English town, Stratford-upon-Avon,, with its 8,000 inhabitants, receives as much space as does the hustling manufacturing city of New Bedford, Mass., over eight times as large. In fact, this same matter of disproportion is admitted by the editors in their preface, and held to be a part of the deliberate plan of the work. It has been resorted to as a means of giving each place an amount of space in accord with its importance aside from mere size. The reader will find in most cases that this rule has operated distinctly toward a greater usefulness and value of the book in general daily reference.

The work is of a monumental character, as will appear to any one who merely turns the pages casually. It is carefully and thoroughly done, as will appear to any one who will read about the places with which one has been familiar for years. The book is a veritable mine of information which practically every one has occasion to use in every-day life. It is a book that is indispensable to the business man, the teacher, the author, in fact, to every one who ever has occasion to refer to any place outside his own town.

The editors and publishers are to be congratulated for the production of a thoroughly reliable, usable, up-to-date gazetteer.

W. S. T.

LOWERY, WOODBURY. *The Spanish Settlements Within the Present Limits of the United States. Florida,* 1562-1574. With Maps. G. P. Putnam's Sons, New York, 1905.

Mr. Lowery has taken up the history of the Spaniards in Florida with the greatest care, showing the student in his work, and an immense amount of research in obtaining his results. Much of the material has been culled from two Spanish writers, the first being Barrientos, professor of Latin in the University of Salamanca. Little is known of him, though much of his information was derived from letters of the admiral who conducted the expeditions to the shores of Florida. The second source of information was from Meras, a brother-in-law of this same admiral, who himself lived the history of those turbulent days in the new possessions. Of the writings of Pedro Menéndez de Avilés, Admiral of Spain, nothing can be found, but they are so quoted by the above two writers, sentence frequently tallying with sentence, so verified by the correspondence of the French and Spanish Ambassadors and contemporary French accounts, that there is little doubt of their one-time existence. From these two writers the author has drawn the sketch of the man chosen by Spain to claim and hold the country now called Florida against the equally covetous French.

Though Avilés constantly seems to have reminded himself that his greatest interest was the supremacy of the Catholic Church and the abolition of the Lutheran—or Frenchman in this instance—he remains throughout the entire history a Spaniard of the Spaniards, merciless to his enemies, and the greed for treasure the real motive of his enterprise. Unlike many of his people, however, it was for his country's good before his own, as time after time instances are sighted where he scorned enormous bribes detrimental to his King.

Mr. Lowery has made a careful research in the archives of Seville, Madrid, Paris and London, also in collections in New York and Washington, and found unpublished documents of much value bearing on this period, which, in his own words, "throws an interesting light on the relations of Catharine de Medici and Philip II in their contest for the possession of Florida. The object of the present volume is rather with the view of bringing out the true attitude of the Spaniards than that of retelling the story of the French Colony." From first to last the book, to one interested historically, reads with exquisite charm.

Charles V, with his countryman's well-known appetite for gold and treasure, sees in those far away shores an inexhaustible mine of wealth, and attempts in many ways to hide his treasure from the world. No foreigners are permitted on his vessels, no maps given to the public till 1790. But the secret places of great treasure seem whispered by the very wind that blows, and the eyes of other lands turn to the West Indies. The French at this time have special reason for refilling an exhausted treasury, and with a slight lack of delicacy proceed to do it by seizing the rich plum belonging to their neighbors, with equal impoliteness establishing various forts along the coast. Philip II realizes that to retain his supremacy and his wealth in the new land strong action must be taken, so wisely and well chooses Avilés to carry out the great scheme of annihilating the intruder and securing against all other nations this treasure-house.

The story of Avilés' work, the man himself, the sketch of Indian life as he found it those cnturies ago (just as we find it to-day), his final success in driving out the obnoxious Frenchman, his barbarity toward the luckless enemy carried forth in the name of religion, his tact with the native, weaves a romance of the sixteenth century more wonderful than fiction. History proves him beyond all bribery, a man of wonderful self-control and courage.

His massacre of the French at Fort Caroline seems to be his one great and inscrutable blunder; but to quote the author once more:

"We must not allow our judgment to be so outraged as to blind us to his signal merits, and Pedro Menéndez de Avilés surely deserves to take rank among the greatest and most gifted of the early discoverers and conquerors of the New World."

MARY T. S. SCHÄFFER.

LUCAS, C. P. *A Historical Geography of the British Colonics.* Vol. II. *The West Indies.* Pp. iv, 348. (Edited by C. Atchley.) Clarendon Press, Oxford, England, 1905.

In this second edition Mr. Atchley has revised, enlarged and brought up to date a valuable work on British colonial possessions.

To every student of history the acquisition of colonies and the growth of empires should present one of the most interesting as well as important phases of modern tendencies. This book, as its title reads, is essentially a treatise on British colonies. And it is fitting that it should be so, since Great Britain was the first of the modern nations to possess a stable, world-wide colonial empire. But though the British in the West Indies form the main theme of the book, the earlier attempts of the Spanish, Portuguese and Dutch are also presented as the appropriate background. It might not be undesirable, however, to give rather more emphasis to the Spanish and Portuguese colonizers, since the British efforts were so greatly influenced by the examples of these two nations.

In the study of the rise of the British Empire the book is valuable as giving in a convenient form the essential steps in acquisition and development, as well as the present condition of the British West Indian possessions. From the standpoint of the geographer there is not enough of the geographic elements which induced and influenced the settlement and growth of the different colonies. These geographic factors are only hinted at in many cases, where a few more well chosen words would have thrust home the part played by physical conditions. In other words, the book affords another example of the great difficulty in combining in one author the training of an accurate historian and an interpreting geographer.

The title of the book gives cause for disagreement. The combination "Historical Geography" may be in fairly common use, but it is none the less a misnomer when applied to books of this nature. The work at hand is a "*geographical history*," and it is this terminology which should receive the sanction of good use both by historians and geographers.

But these are minor points as far as the usefulness of the individual book is concerned, for it is distinctly a valuable book to the student in history, as well as containing many items of geographic interest.

W. S. T.

OKAKURA-YOSHISABURO. *The Japanese Spirit.* James Pott & Co., New York, 1905.

"The Japanese Spirit," by a native Japanese, is a most delightful little book. Modestly the writer tries to express the essence of his people's life and thought to a foreign western people. The book is the outgrowth or the permanent form of lectures on Japan given in the University of London by Mr. Okakura. The preface, by Mr. George Meredith, makes a most tempting stepping stone to the book itself, which is all too brief.

The most fitting thing to say of "The Japanese Spirit" is "Read it yourself; the charm of the book and the 'Spirit' will possess you, and you will long for the time when our western world will have shared some part of the noble flavor of Japan."

Mr. Okakura gracefully closes to his English audience—"when a healthy admixture of the European civilization has been tried—a civilization the effect of which has been, on the whole, so beneficent to our development, that we feel it a most agreeable duty gratefully to acknowledge our immense obligation to the nations of the West."

Let us western people have the wisdom to glean some lessons from the East!

MARY S. HOLMES.

SCOTT, CAPTAIN R. F. *The Voyage of the "Discovery."* 2 vols. Pp. 106
Smith, Elder & Co., London, 1905.

A story of Antarctic exploration told by Captain Scott, commander of the British expedition which sailed from London in July, 1901.

The first volume covers the incidents connected with the plans for the voyage; the preparations and outfitting; the voyage to the ice wall of the Antarctic; wintering on the ice, and the early spring journeys of the season of 1902. The preliminary details of preparation, though much like the accounts of all other Polar expeditions, cannot help but prove interesting to the reader who has never before followed the whole story of a Polar voyage from the inception to the relief party's arrival. The conditions to be met, and overcome, if any degree of success is hoped for, are of such a distinctly specialized nature that there is a fascination in seeing how all these items are considered months beforehand and prepared for thousands of miles away from the scenes of the explorers' activity. Captain Scott has told the story in perhaps too much detail for the average reader, but little of the charm is lost thereby.

The experiences during the winter spent on the ice, near the great ice wall, recount many of the usual occurrences incident to all Polar expeditions, such as the preparation of winter quarters, securing supplies of food, taking of scientific observations and making ready for advance over the ice as soon as winter breaks up. But there are also many other incidents which make the reading of these chapters well worth while. The thrilling experiences of the man lost in the blinding confusion of an Antarctic blizzard, wandering about to the very edge of the ice cliff with the loss of one of their companions in the sea below; the adventure of the eighteen-year-old boy who went forty-eight hours without food, lying buried under the snow for a day and a half of the time, and coming through unhurt, are samples of the kind of experiences which make the account so interesting.

The second volume of the work narrates the occurrences during the summer exploration over the ice in 1902; the second winter season; the return of open weather in 1903, with the resumption of sledging activity; the arrival of the inevitable relief party, and the voyage home. The latter part of the volume contains a general survey of the scientific observations, followed by two appendices giving summaries of the geological observations by H. T. Ferrar, and the biological observations by E. A. Wilson. To the average reader the second volume will prove the more satisfactory, since it contains the accounts of the real activities of exploration and what came of them. While the most important results of the two years' work are isolated from the general narrative in the summaries that make the closing chapters of the book, a large part of the general observations is concerned with the ice phenomena, the pack ice, icebergs, the Great Barrier, its movement and extent, the currents as indicated by ice movements, the inland ice, and speculations concerning former ice conditions and former climate. In connection with the movements of pack ice, it may be interesting to quote from Captain Scott, who says: "Continuing to drift northward, the main pack is dissipated by the beginning of February, and during this month a ship, by coming directly south on the 178th meridian, could reach the Great Barrier without encountering any pack ice. It is strange to think that there may be a season in the year when the enterprising tourist steamer may show its passengers the lofty smoke-capped form of Mount Erebus as easily as it now does the fine scenery of Spitzbergen." Mount Erebus is in about 78° south latitude.

A point of interest to the geologist is found in Captain Scott's discussion of former climate. He says: "A word may be added as to the change of climate which has caused the recession of the ice conditions in the Far South. It has been a surprise to me to find that the idea that a great glacial epoch is the result of a comparatively mild climate is supported by much authority. Both Mr. Ferrar and I arrived at this conclusion independently when in the South. The chief argument in its favor is that it is physically impossible for cold air to contain much moisture, but living in a severe climate it was impossible not to realize that greater severity would have meant more sterile ice conditions. In this connection it is also interesting to note that our greatest snowfall occurred in summer, and that the Balleny Islands are more heavily glaciated than Victoria Land.

"There can be little doubt, therefore, that at the time of maximum glaciation the climate of Victoria Land was milder than it is at present."

The Balleny Islands referred to as more heavily glaciated than Victoria Land lie some ten or more degrees farther from the pole. Nordenskjöld's discovery of Jurassic and Tertiary fossil plants in Antarctic strata also indicate milder climatic conditions in former times, and help to throw light on the interesting question of glacial origin.

It is to be regretted that there is not more of truly scientific value to fill the pages of these volumes, for, taken as a whole, the book is more a narrative account of exploring experiences than it is valuable as an exposition of scientific results. The style is simple, straightforward and attractive in its ease of reading, despite the author's disclaimer of either literary experience or ability. Several hundred excellent photographs, both in black and white and in colors, add a pleasing touch of reality to the places mentioned in the text. The colored photographs are especially worthy of mention as being of a character not often associated with books of this scope. They are the work of Dr. Wilson, the biologist of the expedition, and give as nothing else could an idea of the gorgeous beauties of polar seas and skies. Without exception, the illustrations are of an unusually high grade, but in order to appreciate the colored plates alone it is well worth while to read the whole book.

In a few words, Captain Scott had an interesting story to tell. He has told it in an attractive way, marred here and there, it is true, by too much of detail, but withal very readable and finely illustrated.

WALTER S. TOWER.

Recent Accessions to the Library of the Society.

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Egypt .... Dicey

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Three Visits to Madagascar. By Rev. William Ellis, F.H.S. New York: Harper & Bros., 1859. Illustrations.

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Stately Homes in America. By Harry W. Desmond and Herbert Croly. New York: D. Appleton & Co., 1903. Illustrations.

UNITED STATES—DEPARTMENT OF AGRICULTURE.................. ABBE

A First Report on the Relations Between Climates and Crops. By Cleveland Abbe. (United States Department of Agriculture, Bulletin No. 36.) Washington, 1905.

UNITED STATES—FLORIDA .... LOWERY

The Spanish Settlements Within the Present Limits of the United States. Florida, 1513-1561. Vol. 2, 1562-1574. By Woodbury Lowery. New York: G. P. Putnam's Sons, 1901-1905. Maps. *Presented by the Publishers. To be Reviewed.*

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Report of the Operations of the Coal-Testing Plant of the United States Geological Survey at the Louisiana Purchase Exposition, St. Louis, Mo., 1904. By the Committee in Charge. (United States Geol. Surv. Prof. Paper No. 48, 3 parts.) Washington, 1906. Illustrations and Maps.

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Views in the Environs of London. Text by William Edward Trotter. London, 1839. *Presented by S. L. Schumo.*

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Travels of a Naturalist in Northern Europe. By J. A. Harvie-Brown, F.R.S.E., F.Z.S. London: T. Fisher Unwin, 1905. Illustrations and Maps. 2 vols. *Presented by the Publisher. To be Reviewed.*

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SWITZERLAND .... BEATTIE

Views in Switzerland. By William Beattie, M.D. Illustrated by W. H. Bartlett. London: George Virtue, 1836. 2 vols. *Presented by S. L. Schumo.*

OCEANICA.

NEW SOUTH WALES—METEOROLOGY .... RUSSELL

Results of Meteorological Observations in New South Wales during 1900, 1901 and 1902. Under the direction of H. C. Russell. Sydney, 1904.

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Index to the Islands of the Pacific. By William T. Brigham. Honolulu: Bishop Museum, 1900. Maps. *Presented by Frank Miles Day.*

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The Siege of the South Pole. By Hugh Robert Mill, D.Sc., LL.D. New York: Fred. A. Stokes Company, 1905. Illustrations and Maps. *Presented by the Author. To be Reviewed.*

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In the Lena Delta. By Rear Admiral George W. Melville. Boston: Houghton, Mifflin & Co., 1884. Illustrations and Maps. *Presented by the Author.*

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Hans the Eskimo. By Christiana Scandlin. New York: Silver, Burdett & Co., 1903. Illustrations. *Presented by the Publishers.*

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LITTLE

The World as We Saw It. By Mrs. Amos R. Little. Boston: Cupples & Co., 1887. Illustrations. *Presented by Miss E. E. Massey.*

GOODRICH

The Universal Traveller. By Charles A. Goodrich. Hartford: Canfield & Robins, 1838. Illustrations. *Presented by S. L. Schumo.*

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New Ancient Geography. By S. Augustus Mitchell. Philadelphia: E. H. Butler & Co., 1860. Illustrations. *Presented by Miss E. E. Massey.*

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Houston's New Physical Geography. Revised Edition. By Edwin J. Houston. Philadelphia: Noble & Eldredge. Illustrations and Maps. *Presented by the Publication Committee.*

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Geography Primer. By Oliver P. Cornman and Oscar Gerson. Philadelphia: Hinds, Noble & Eldredge, 1905. Illustrations and Maps. *Presented by the Publication Committee.*

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Malte-Brun's Geography. Boston: Samuel Walker, 1834. 3 vols. Illustrations and Maps. *Presented by S. L. Schumo.*

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Potter's Advanced Geography. By Eliza H. Morton. Philadelphia: Hinds, Noble & Eldredge. Illustrations and Maps. *Presented by the Publication Committee.*

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Hawaiian Feather Work. By William T. Brigham. Honolulu: Bishop Museum, 1899. Illustrations. *Presented by Frank Miles Day.*

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Atlas to Accompany Monograph 32 on the Geology of the Yellowstone National Park. By Arnold Hague. Washington, 1904.

Map of Ontario and Keewatin, Rainy River Sheet. *Presented by James White, F.R.G.S., Geographer.*

United States Hdyrographic Office Charts.

North Atlantic Ocean for April. May and June, 1906.

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British and United States Hydrographic Office Charts of the Northeast Coast of North America. *Presented by Henry G. Bryant.*

Maps of Canadian National Park. *Presented by Henry G. Bryant.*

Hydrographic Office Circumpolar Chart. *Presented by Henry G. Bryant.*

Geographical Society

OF PHILADELPHIA

CHARTER, BY-LAWS
LIST OF MEMBERS

DECEMBER, 1903

1520 CHESTNUT STREET
PHILADELPHIA

Geographical Society

OF

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CHARTER, BY-LAWS
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DECEMBER, 1903

1520 CHESTNUT STREET
PHILADELPHIA

PRESS OF
FRANKLIN PRINTING COMPANY
514-520 LUDLOW STREET
PHILADELPHIA

OFFICERS, 1903-1904

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PROF. ANGELO HEILPRIN

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The Geographical Society of Philadelphia

Organized as the Geographical Club of Philadelphia

HISTORY

The inception of the Geographical Society of Philadelphia is found in a call for the organization of such association, bearing date of March 10, 1891.

A preliminary meeting of organization was held in the Academy of Natural Sciences on March 19th. It was then recommended that a Constitution and By-Laws be drafted for presentation at the next meeting.

On the 30th of the same month, in the hall of the Academy of Natural Sciences, on Logan Square, a preliminary meeting for the purpose of framing articles of association was held.

At this meeting Professor Heilprin was asked to take the chair, and Dr. Benjamin Sharp acted as Secretary. Provisional articles of association were submitted.

At a meeting held on April 20th, in the hall of the Academy of Natural Sciences, the articles of association framed at the last meeting were formally adopted, and Prof. Angelo Heilprin was elected President.

The broad purposes of the organization rapidly attracted to it the interest of the community, and before the close of November, 1891, 104 names had already been enrolled for membership. The first stated meeting was held in the new lecture hall of the Academy of Natural Sciences, on February 24, 1892, when the President read an opening address on the "Present Aspects of Geographical Study." Other addresses were delivered by Vice-President Edward H. Weil and by Dr. D. G. Brinton ("On the Relations of Earth to Man"). The number of stated and special meetings up to this date has been as follows:

February to May, 1892, inclusive, three stated meetings.

November, 1892, to May, 1893, inclusive, seven stated meetings.

November, 1893, to May, 1894, inclusive, seven stated meetings.

November, 1894, to May, 1895, inclusive, seven stated meetings.

November, 1895, to May, 1896, inclusive, seven stated meetings and one special meeting.

November, 1896, to May, 1897, inclusive, seven stated and two special meetings.

November, 1897, to May, 1898, inclusive, seven stated meetings.

November, 1898, to May, 1899, inclusive, seven stated meetings and one special meeting.

November, 1899, to May, 1900, inclusive, seven stated, three special meetings, and two intermonthly meetings; an educational course of nine afternoon lectures.

November, 1900, to May, 1901, inclusive, seven stated meetings, one special meeting, and three intermonthly meetings.

November, 1901, to May, 1902, inclusive, seven stated meetings and one special meeting.

November, 1902, to May, 1903, inclusive, seven stated meetings.

November, 1903, to May, 1904, inclusive, seven stated meetings, one special meeting, and three intermonthly meetings.

November 4, 1903. Annual Address by the President, Prof. Angelo Heilprin; "The Town of Pelée: New Researches in Martinique."

December 2, 1903. Address by Dr. Frederick A. Cook: "Explorations in the McKinley Range, Alaska."

January 6, 1904. Address by Prof. William Morris Davis, of Harvard University: "A Journey in Turkestan."

February 3, 1904. Address by Mr. A. J. Drexel Biddle, F. R. G. S.: "In the Madeira Islands."

February 26, 1904. (Intermonthly Meeting.) Addresses by Miss Laura Craven: "An Artist's Glimpse of Tangier"; Dr. Theodore Le Boutillier: "Views of Tangier and North Africa"; Dr. John W. Harshburger: "Tropical Vegetation in Jamaica"; Maj. Wright, Ninth U. S. Cavalry: Report of a First Ascent of the Volcano, Mayon, Luzon, P. I. (submitted through the President of the Society); Prof. Angelo Heilprin: "Exhibition of Objects from Saint Pierre."

March 2, 1904. Address by Dr. Philip Jaisohn, late Special Advisor to the Privy Council of His Korean Majesty: "Korea and its People."

March 23, 1904. (Special Meeting.) Addresses by Mr. and Mrs. Gilbert McClurg: "Peak, Pass, and Plain: Colorado's Pre-Columbian Past and Romantic Development."

April 1, 1904. (Intermonthly Meeting.) Addresses by Miss Dora Kean: "Colors and Scenes in Old Bokhara"; Prof. Emory R. Johnson: "Early Transportation in the United States"; Prof. Angelo Heilprin: "Observations on Commander Peary's New Map of the Polar Regions."

April 6, 1904. Address by Prof. E. L. Stevenson, of Rutgers College: "The Early Cartography of the New World, Exhibiting the Famous Waldsseemüller and Other Maps."

April 29, 1904. (Intermonthly Meeting.) Consideration and passage of amendments to the By-Laws. Addresses by Dr. John W. Harshburger: "Vegetation of the North American Deserts"; Mrs. Roberts Le Boutillier: "A Visit to Timegad, an African Pompeii"; Mr. Henry G. Bryant: "A Trip to Mexico."

May 4, 1904. Presentation of the Elisha Kent Kane Medal to Capt. Robert F. Scott, R. N. Acceptance on behalf of Capt. Scott by Wilfred Powell, Esq., H. B. M.'s Consul at Philadelphia. Address by Prof. Herschel C. Parker, Columbia University, N. Y.: "Mountaineering in the American Alps, First Ascents of Mts. Goodsir, Hungabee, Deltaform, and Biddle."

November 2, 1904. Annual Address by the President, Mr. Henry G. Bryant: "Mexico and Its People, Including the Ascent of Popocatepetl."

November 25, 1904. (Intermonthly Meeting.) Addresses by Dr. J. Russell Smith: "The Economic Importance of the Plateau in Tropical South America"; Mr. William W. Canby: "Life Among the Indians of Northern Alaska"; Dr. Theodore Le Boutillier: "Views Along the North Coast of Cuba."

December 7, 1904. Address by Miss Laura Bell: "A Winter in India."

December 16, 1904. (Intermonthly Meeting.) Addresses by Prof. Emory R. Johnson: "The Extent and Efficiency of Governmental Promotion of Commerce in the Leading Countries"; Mr. Thomas R. Hill: "Pioneer Traveling on the Koyukuk River, Alaska."

January 4, 1905. Address by Mr. Oscar T. Crosby, Washington, D. C.: "Turkestan and a Corner of Tibet.

January 20, 1905. (Intermonthly Meeting.) Addresses by Mr. Walter Sheldon Tower: "Physiographic Control of Travel in Pennsylvania"; Dr. John W. Harshburger: "A Comparison of the Alpine Floras of Mounts Katahdin, Washington, and Marcy"; Dr. Thomas S. Dedrick: "Rites, Superstitions, and Traditions of the Eskimos."

February 1, 1905. Prof. Samuel M. Lindsay, late Commissioner of Education in Porto Rico: "Porto Rico: Recent Changes Affecting the Island and Its People."

February 10, 1905. (Intermonthly Meeting.) Addresses by Dr. Philip Jaisohn: "Comments on Physical and Climatic Conditions in Manchuria"; Miss Laura Bell: "Some Phases of Life in Chinese Cities."

During its existence, meetings of the Society have been held at the hall of the Academy of Natural Sciences, the New Century Drawing Room, the Pennsylvania Academy of Fine Arts, Griffith Hall, the Odd Fellows' Temple, Horticultural Hall, and Witherspoon Hall.

By a vote of the Club (at a meeting held December 2, 1896), acting on the recommendation of the Board of Directors, it was resolved to change the name of the organization into the Geographical Society of Philadelphia; the application for such change was granted by the Court of Common Pleas of Philadelphia, April 8, 1897.

As part history of the Society to the present date, should be mentioned its association, through a generous contribution of funds, with the Peary Arctic Expedition of 1893, and the Peary Auxiliary Expedition of 1894.

On February 2, 1896, the Haseltine Building, in which the Society had secured a room for use as a library, was destroyed by fire, and by it the Society lost its full possessions, including its books, the Charter, Bulletins, and exchanges.

In the spring of 1899, an interesting experiment, known as the Melville-Bryant Drift Cask Project to determine the direction and speed of Arctic currents, was successfully inaugurated by the Society.

Four awards of the Elisha Kent Kane Medal have been made, as follows: to Dr. A. Donaldson Smith, to Commander Robert E. Peary, to Prof. Angelo Heilprin, and to Capt. Robert F. Scott, R. N.

The following "Bulletins" have been issued:

"Mountain Exploration," by Mr. Edwin Swift Balch; "A Journey to the Grand Falls of Labrador," by Mr. Henry G. Bryant; "The Progress of Discovery and the Lands of Promise to the Explorer," by Prof. Angelo Heilprin; "Some Facts about Alsace-Lorraine," by Mr. Thomas Willing Balch; "The Peary Auxiliary Expedition of 1894," by Mr. Henry G. Bryant; "A Trip to Manika Land," by Mr. J. Edward Farnum; "Venezuela's

Professor in Harvard University; "Manners and Customs of the People of Southern Borneo," by H. M. Hiller; "Report of the Brown-Harvard Expedition to Nachvak, Labrador, in the year 1901," by E. B. Delabarre, Ph. D., Professor in Brown University; "The Stream Contest Along the Blue Ridge," by W. M. Davis, Professor in Harvard University.

CHARTER

OF THE

Geographical Club (Society) of Philadelphia

BE IT KNOWN THAT, The subscribers, having associated themselves for the purpose of organizing the GEOGRAPHICAL CLUB OF PHILADELPHIA, and being desirous of becoming incorporated agreeably to the provisions of an Act of the General Assembly of the Commonwealth of Pennsylvania, entitled "An Act to provide for the Incorporation and Regulation of certain Corporations," approved the twenty-ninth day of April, A. D. 1874, and its supplements, do hereby declare and certify that the following are the purposes, objects, articles and conditions of their said association, for and upon which they desire to be incorporated:

I. The name of the proposed corporation is GEOGRAPHICAL CLUB OF PHILADELPHIA.

II. The purpose for which the corporation is formed is the advancement of the science of geography and of geographical studies and exploration, the recording of discoveries, the presentation of researches, and the accumulation of works on geography.

III. The place where the business of the corporation is to be transacted is the city of Philadelphia, State of Pennsylvania.

IV. The corporation is to exist perpetually.

V. The names and residences of the subscribers are as follows: Angelo Heilprin, 1417 North Sixteenth Street, Philadelphia; Edward H. Weil, 1720 Pine Street, Philadelphia; Edward H. Williams, Rosemont, Pa.; Henry G. Bryant, 2013 Walnut Street, Philadelphia; Mary Wager Fisher, Bryn Mawr, Pa.; F. Lynwood Garrison, Radnor, Pa.; Sarah C. F. Hallowell, 2017 DeLancey Place, Philadelphia; Daniel G. Brinton, 2041 Chestnut Street, Philadelphia; Edwin Swift Balch, 1412 Spruce Street, Philadelphia; Coleman Sellers, Jr., 410 North Thirty-third Street, Philadelphia; Anna Williams Dreer, 101 North Thirty-third Street, Philadelphia; George Gluyas Mercer, 641 North Sixteenth Street, Philadelphia; Frances May Bockius, 1901 North Logan Square, Philadelphia; Martha Bunting, 2000 Arch Street, Philadelphia; Mary Blakiston, 2042 Chestnut Street, Philadelphia; Gavin W. Hart, 1316 Spring Garden Street, Philadelphia; Benjamin Smith Lyman, 708 Locust Street, Philadelphia; Thomas Meehan, Chew Street, Germantown, Philadelphia; Edward J. Nolan, 825 North Twentieth Street, Philadelphia; Robert E. Peary, Washington, D. C.; Benjamin Sharp, 317 North

Geographical Society of Philadelphia

Room 314 Baker Building **1520 Chestnut Street**

Special Announcement

Course of Lectures by Professor Heilprin.

The Board of Directors is pleased to announce that Professor Heilprin has consented to give a course of six lectures on current geographic topics during the month of April. The lectures will be given in Westminster Hall, Witherspoon Building. Tickets of admission to these lectures may be obtained from the Secretary of the Geographical Society, 1520 Chestnut Street. The price of the tickets for members will be $1.00, and for persons not members of the Society will be $2.00.

The Society's New Room. The attention of the members and their friends is called to the fact that the Society and its library are now commodiously housed in a large front room on the third floor of the Baker Building, 1520 Chestnut Street. The library is steadily growing as the result of the generosity of friends of the Society. All members are urged to make frequent use of the library. The room is open in the morning from 10 to 12, and during April and May will be open certain afternoons. Members desiring to use the library for special research work, may secure a key to the room by applying to the librarian.

One of the pleasant social features of the Society is the "Geographical Tea," given by a special committee of ladies in the room of the Society each month during the winter and spring.

Membership. The growth of the membership of the Society during the past two years has been most gratifying. The larger membership is permitting the Society gradually to widen the scope of its activities. It is hoped that the members will make known to their friends the advantages secured through membership in the Society. The two regular meetings of the Society each month from November to May, inclusive, the Fall and Spring excursions, the special courses of lectures, such as the one to be given by Professor Heilprin this year, the library facilities afforded at the room of the Society, and the Bulletins issued by the Society, enable the Geographical Society of Philadelphia to offer its members exceptional advantages. Membership in the Society may be secured by making application to the Board of Directors. The By-Laws of the Society require that the application shall be endorsed by two members of the Society having a personal acquaintance with the applicant.

Annual and Life Membership Fees. The annual fee is $5.00. **After the first of May there will be an initiation fee of $5.00.** Those intending to join the Society will do well to make application for membership before the first of May. At the present time the **life membership** fee is $50.00, after the first of May it will be raised to $100. It is thought probable that some of those who are now on the annual membership basis may desire to be transferred to the roll of life members before the first of May, and also that some of those who join the Society before now and the first of May may prefer to become life members. The money received from the life membership fees is permanently invested, and the income is used for the promotion of the work of the Society. By enrolling as a life member, one may strengthen the work of the Society and become a patron as well as a member.

Thirty-fifth Street, Philadelphia; Henry Skinner, 716 North Twentieth Street, Philadelphia; Albert B. Weimer, 1934 Wallace Street, Philadelphia.

VI. The officers of the corporation shall be a President, a First and Second Vice-President, a Recording Secretary, a Corresponding Secretary, and a Treasurer, who, together with seven Directors, shall form the Board of Directors, to which shall be entrusted the management of the affairs of the corporation. The names of those chosen Directors for the first year are: Angelo Heilprin, President, 1417 North Sixteenth Street, Philadelphia; Edward H. Weil, First Vice-President, 1720 Pine Street, Philadelphia; Edward H. Williams, Second Vice-President, Rosemont, Pa.; Henry G. Bryant, Recording Secretary, 2013 Walnut Street, Philadelphia; Mary Wager Fisher, Corresponding Secretary, Bryn Mawr, Pa.; F. Lynwood Garrison, Treasurer, Radnor, Pa.; Edwin Swift Balch, 1412 Spruce Street, Philadelphia; Daniel G. Brinton, 2041 Chestnut Street, Philadelphia; Anna Williams Dreer, 101 North Thirty-third Street, Philadelphia; Sarah C. F. Hallowell, 2017 DeLancey Place, Philadelphia; Coleman Sellers, Jr., 410 North Thirty-third Street, Philadelphia; Mary Blakiston, 2042 Chestnut Street, Philadelphia; Albert B. Weimer, 1934 Wallace Street, Philadelphia.

VII. The corporation has no capital stock.

VIII. The yearly income from said corporation, other than that derived from real estate, will not exceed the sum of $50,000.

WITNESS our hands and seals this tenth day of April, Anno Domini One Thousand and Eight Hundred and Ninety-three.

ANGELO HEILPRIN, [Seal]
EDWARD H. WEIL, [Seal]
EDWARD H. WILLIAMS, [Seal]
HENRY G. BRYANT, [Seal]
ALBERT B. WEIMER, [Seal]
F. LYNWOOD GARRISON, [Seal]
GEORGE GLUYAS MERCER, [Seal]
FRANCES MAY BOCKIUS, [Seal]
MARTHA BUNTING, [Seal]
MARY BLAKISTON, [Seal]
GAVIN W. HART, [Seal]
SARAH C. F. HALLOWELL, [Seal]
D. G. BRINTON, [Seal]
EDWIN SWIFT BALCH, [Seal]
COLEMAN SELLERS, JR., [Seal]
MARY WAGER FISHER, [Seal]
ANNA WILLIAMS DREER, [Seal]
BENJ. SMITH LYMAN, [Seal]
THOMAS MEEHAN, [Seal]
EDW. J. NOLAN, [Seal]
R. E. PEARY, [Seal]
BENJ. SHARP, [Seal]
HENRY SKINNER. [Seal]

Geographical Society of Philadelphia

BY-LAWS

ARTICLE I

OBJECTS

The objects of the Society are

(1) The furtherance of the Science of Geography and the promotion of geographical studies generally.

(2) The interchange of experiences of travel at home and abroad.

(3) The recording of discoveries, and the presentation of researches by means of lectures, photographic and other exhibitions.

(4) The promotion of geographical exploration.

(5) The accumulation of works on geography and photographs of scenery and people.

ARTICLE II

MEMBERSHIP

There shall be four classes of membership:

(1) ACTIVE OR RESIDENT MEMBERS, who shall pay an initiation fee and annual dues as fixed by the Board of Directors, and shall have the privileges of voting and holding office.

(2) NON-RESIDENT MEMBERS, who are those living more than twenty-five miles from Philadelphia. They shall pay one-half the annual dues, and shall be entitled to attend the Society meetings and to receive its publications. They may assume the privileges of active members at any time on payment of full annual dues and initiation fee.

(3) CORRESPONDING MEMBERS, who may be chosen from the officers of other geographical or scientific societies and from those who have contributed to geographical knowledge, or are engaged in geographical exploration or other correlated scientific work. They shall be exempt from the payment of dues and shall have all the privileges of active members except those of voting and holding office.

(4) HONORARY MEMBERS. Only those who have distinguished themselves in the field of geographical knowledge or exploration shall be eligible to Honorary membership. The number of Honorary members shall not exceed twenty-five at any one time. They shall be exempt from the payment of dues and shall have the privileges of other members.

Nominations for Active membership shall be made by one member and seconded by two other members having personal knowledge of the nominee. Nominations for Non-resident membership may be made by any member of the Society. Nominations for Active and Non-resident membership shall be submitted to the Board of Directors, who shall have power to act on such nominations.

Corresponding and Honorary members shall be nominated to the Board of Directors at any regular meeting of the Board. Action on the names proposed shall be taken at the next regular Board meeting, and must be unanimous.

The annual dues shall be fixed by the Board of Directors, and shall not exceed $5, payable on or before the first day of January in each year. Members elected at the May and October meetings shall be assessed one-half the amount of the annual dues. Members elected in November and December shall not be assessed for dues until the January first following their election. Members whose dues are unpaid on April 1st shall be notified by the Treasurer, and any member in arrears six months after such notification may be suspended or dropped by the Board of Directors.

Any member or member-elect may become a Life member by the payment of one hundred dollars, and in such case shall not be liable for further dues, and shall have the privileges and rights of an Active member. All payments for Life membership shall be invested to form a fund whose annual income shall be used for such purposes as the Society may hereafter direct.

ARTICLE III

SOCIETY MEETINGS

The Annual Meeting of the Society shall be held on the evening of the first Wednesday in November, at which meeting the President shall deliver an address on the progress of geographical discovery during the year, either general or special, or relating to special researches made in connection with geographical inquiry.

The other regular meetings of the Society shall be held monthly, on the evenings of the first Wednesday of each month from November to May, inclusive, unless otherwise ordered by the Board of Directors.

Each member shall be provided with a membership card, and the Resident members, in addition, with two invitation cards for each meeting, each card admitting but one person. It shall be within the discretion of the Board of Directors to issue additional cards, or to withhold, on special occasions, the supplemental cards. No person shall be admitted without a card, unless personally known to the attendant as a member.

Special meetings of the Society may be called by the Board at its discretion, and shall be called upon the written request of four members of the Board, addressed to the President.

ARTICLE IV

BOARD AND BOARD MEETINGS

The Board of Directors shall consist of the officers and twelve Directors, six of whom are to be elected annually to serve for a term of two years each, and not to be eligible for re-election for the ensuing term.

Meetings of the Board of Directors for general business shall be held in each month from October to May, inclusive, on such day as the Board shall from time to time appoint and announce to the Society. Special meetings of the Board may be called by the President at his discretion and shall be called by him at the written request of four members of the Board.

At all meetings of the Board seven members present shall constitute a quorum for the transaction of business.

Members of the Board of Directors who have absented themselves from three consecutive stated meetings of the Board, without the presentation of excuse for such absence, shall be considered to have forfeited their seats, and the places so left vacant shall be filled (by appointment) by the Board of Directors.

ARTICLE V

ANNUAL ELECTIONS

The Annual Election shall take place at the regular May meeting, when there shall be elected:

(1) The President, Vice-Presidents, Secretaries, and Treasurer for the ensuing year.

(2) Six Directors, who shall serve for two years, and who shall not be eligible for re-election for the ensuing term.

(3) Four members of the Excursion Committee and four members of the Reception Committee for the ensuing year.

No person shall be eligible for the office of President or for the office of Vice-President for more than two consecutive years, nor shall Directors, elected as such, be eligible for consecutive terms of such service.

A Nominating Committee, to consist of five members of the Society, shall be appointed by the President at the March meeting of the Society, which committee shall report to the Society at its regular April meeting their nomination for Officers, Directors, and Standing Committees of the Society; at which meeting also any five members may unite in presenting in writing an additional nomination for any office, provided such nominee has consented to serve, if elected; or may within one week after the April meeting send such nomination to the Recording Secretary by mail.

The election shall be by secret ballot, after the Australian method, on tickets furnished by the Board of Directors, containing in alphabetical order the names of all persons nominated for the respective offices, and having a blank space where the voter may write the name of any one not nominated for whom he may wish to vote. Each member shall mark his ticket with a cross (X) opposite the name of the person he desires to vote for. If a voter marks more names than there are persons to be elected to an office, or if, for any other reason, it is impossible to determine the voter's choice, his ballot shall not be counted for such office.

No member shall have the right to vote whose dues are in arrears at the time of the annual election.

ARTICLE VI

COMMITTEES

The President shall, at the April meeting of the Society, appoint an Auditing Committee, consisting of two Society members, whose duty it shall be to examine the Treasurer's accounts, determine their correctness, and certify the same to the Society at its May meeting.

There shall be Standing Committees of the Society on Excursions and on Receptions, each consisting of four members elected by the Society and a Chairman appointed from the Board of Directors by the President.

The Standing Committees of the Board of Directors shall be:

(1) The Executive Committee.
(2) The Finance Committee.
(3) The Entertainment Committee.
(4) The Publication Committee.

The Executive Committee shall consist of the President, the two Vice-Presidents, and the two Secretaries, whose duty it shall be to arrange for the stated meetings of the Society, and to prepare suitable programs for presentation at them.

The Finance Committee shall consist of three members, and shall have a general oversight of the receipts, expenditures, and investments of the Society, and shall, before the February stated meeting of the Board, examine and certify the Treasurer's accounts and vouchers for the previous calendar year, and report to the Board at the said meeting the result of their examination and the amount of the cash balance in the Treasurer's hands.

The Entertainment Committee shall consist of at least three members, and shall include the ladies who may be members of the Board of Directors.

The Publication Committee shall consist of at least three members.

All necessary appointments to the Standing Committees shall be made by the President at the stated meeting of the Board in May.

Additional Standing Committees may be constituted hereafter by either the Society or the Board of Directors, as may be found expedient by them respectively.

ARTICLE VII

PUBLICATIONS, PROFESSORSHIPS AND MEDALS

The publications of the Society shall be known as the BULLETIN OF THE GEOGRAPHICAL SOCIETY OF PHILADELPHIA, and shall contain matter referring only to geographical knowledge, or that which is pertinent to the interests of the Society. It shall be under the direction of the Publication Committee.

The Board of Directors shall have the power to create Honorary Professorships of Political and Historical Geography; Physical and Descriptive Geography; Anthropo-Geography; Military and Naval Geography; and Cartographical and Topographical Geography.

A medal, to be known as the Elisha Kent Kane Medal of the Geographical Society of Philadelphia, may be awarded annually by the Society, on the recommendation of the Board of Directors, to such person as may be designated by a three-fourths vote of the entire Board of Directors, and approved by the majority of the members present at the meeting, and only for important geographical exploration or research made during the twenty-four months preceding the award. The award shall be made at the May meeting of the Society.

ARTICLE VIII

These By-Laws may be amended by the affirmative vote of two-thirds of the members present at any meeting, provided that notice of the intended amendment, with a copy of the proposed amendment, shall have been given at a previous monthly meeting.

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Lippincott, Mrs. J. Bertram,
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Lippincott, Miss Susan W.,
Cinnaminson, N. J.

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Colorada Springs Gazette,
Colorado Springs, Col.

McCape, Mrs. C. J.,
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McCauley, Mrs. Edward V.,
2300 North Broad St.

McConnell, Mrs. S. D. (non-res.),
781 Madison Ave.,
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McCreight, Miss M. Esther,
409 Chestnut St.

McDevitt, Rev. Philip,
St. John's Rectory,
21 South 13th St.

McKinley, Mrs. Frances T. P.,
115 South 16th St.

McKinley, Mrs. Wm. A. A.,
268 South 38th St.

McKnight, Miss Martha A.,
4026 Chestnut St.

McLaughlin, Mr. Wm.,
2243 North Franklin St.

McLean, Capt. T. C., U. S. N.
(non-res.),
League Island, Phila.

McLeod, Dr. George I.,
1225 Sansom St.

Mein, Mrs. Benjamin V.,
1621 Green St.

Mercer, Mr. George G.,
1133 New Land Title Bldg.

Mercer, Mr. Henry C.,
Doylestown, Pa.

Miles, Mr. Edward S.,
314 South Broad St.

Miller, Mr. Benjamin,
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Mills, Dr. J. M. (non-res.),
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New York, N. Y.

Milne, Mr. David (life mem.),
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Mitchell, Mr. Benj. W., Ph. D.,
4326 Pine St.

Mitchell, Miss Mary A.,
4405 Pine St.

Mitchell, Mr. Wilson,
262 South 17th St.

Mitchell, Mr. W. K.,
Betz Bldg.

Monroe, Mr. Edwin Pear,
408 Lippincott Ave.,
Riverton, N. J.

Montgomery, Miss Mary,
Overbrook, Phila.

Moore, Miss Anna L.,
113 South 38th St.

Moore, Dr. Wm. H.,
1002 North 6th St.

Morris, Mr. Charles,
2223 Spring Garden St.

Morris, Miss Kate,
2223 Spring Garden St.

Motteram, Mr. Wm. C.,
1504 Willington St.

Mucklé, Col. M. Richards,
1722 Pine St.

Murdock, Mrs. Sarah K.,
22 Westview St.,
Pelham, Gtn., Phila.

Murphy, Miss Letitia C.,
1719 Fairmount Ave.

Murphy, Mr. Walter L.,
"The Belgravia,"
1811 Chestnut St.

Murphy, Mrs. Wm.,
"The Belgravia,"
1811 Chestnut St.

Myers, Dr. Jane V.,
Cynwyd, Pa.

Nash, Mrs. Wm. H. (non-res.),
1306 Berwyn Ave.,
Edgewater, Chicago, Ill.

Neall, Miss Marie A.,
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36th and Chestnut Sts.

Newbold, Mr. Clement B.,
1313 Locust St.

Newhall, Miss Abby,
4048 Spruce St.

Nichols, Miss Ida C.,
747 North 26th St.

Nicholson, Mr. John L.,
110 Walnut St.

Nicholson, Dr. Maude L.
(non-res.),
Care Mr. John L. Nicholson,
110 Walnut St.

Nicholson, Miss Rebecca E.,
Care Mr. John L. Nicholson,
110 Walnut St.

Noble, Miss Margaret,
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1313 Pine St.

Orne, Miss S. B.,
30 S. 34th St.

Palmer, Dr. E. Carlton,
1311 North Broad St.

Pancoast, Mr. Charles R.,
Heed Bldg.,
1215 Filbert St.

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Care John Y. Parke.
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Parker, Prof Herschel C.
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Pascoe, Mr. Charles H.,
2602 North 11th St.

Patten, Miss Alice M.,
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Patterson, Miss Laura E.,
2352 North Broad St.

Patterson, Miss S. E.,
703 Land Title Bldg.

Paul, Mr. James W., Jr.,
3809 Locust St.

Paul, Mr. Mickle C.,
3310 Baring St.

Peacock, Miss Mary Craig,
Torresdale, Pa.

Pearsall, Miss Henrietta W.,
1615 Arch St.

Pechin, Miss L. S.,
243 South 13th St.

Peirce, Mr. Harold,
222 Drexel Bldg.

Perot, Mrs. Effingham,
Ardmore, Pa.

Perot, Mr. Wm. Sansom, Jr.,
1920 Pine St.

Pershing, Mr. Thed.,
127 Cliveden Ave.,
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Phreaner, Dr. Wm. A.,
304 Crozer Bldg.,
1420 Chestnut St.

Platt, Dr. Chas.,
3610 Baring St.

Pollak, Mr. Gustav (non-res.),
219 West 138th St.,
New York, N. Y.

Pollock, Mr. W. C., Jr.,
1727 Montgomery Ave.

Pollock, Mrs. W. C.,
1727 Montgomery Ave.

Porter, Mr. Isaac, Jr.,
4809 Regent St.

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222 South 4th St.

Prichard, Miss Margaret S.,
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410 Walnut St.

Rainier, Miss Mary S.,
1718 North 15th St.

Rau, William H.,
Juniper and Chestnut Sts.

Rawle, Mr. Wm. Brooke,
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Reilly, Mr. Garrett L.,
2015 De Lancey St.

Reilly, Mr. John, Jr.,
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Remington, Dr. Jos. P.,
1832 Pine St.

Rittenhouse, Mr. Jos. G., Jr.,
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Roberts, Mrs. Charles (life mem.),
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Roberts, Mr. Hiram C.,
10th St.,
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Robertson, Mr. A. D.,
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Robinson, Mr. Anthony W.
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Roop, Mr. J. Howard,
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Rorer, Mr. Jonathan T.,
3231 Spring Garden St.

Ross, Miss Anna C., P. D.,
230 South 4th St.

Rothermel, Mr. John G.,
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Rothermel, Mrs. P. F., Jr.,
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Rowland, Mrs. Wm. N.,
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Sachs, Mr. Arthur (non-res.),
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Moylan P. O.,
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Shoenberger, Miss Mary,
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Shrigley, Mr. James B.,
1826 Wallace St.

Shrigley, Mr. John M.,
Lansdowne, Pa.

Shriver, Mr. Edgar B.,
2129 North 15th St.

Shryock, Mr. Allen (life mem.),
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Shryock, Mr. W. A. (life mem.),
21 North 7th St.

Shryock, Mr. W. K. (life mem.),
21 North 7th St.

Shryock, Mrs. W. K. (life mem.),
21 North 7th St.

Silliman, Mrs. Estelle Day,
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37th and Chestnut Sts.

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Smyth, Miss Bertha V.,
2128 Vine St.

Smyth, Miss Martha,
411 High St.,
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Snively, Rev. S. E., M. D.,
63d and Market Sts.

Snow, Miss Laura E.,
1815 Columbia Ave.

Snyder, Mr. John M.,
1628 Allegheny Ave.

Speakman, Mrs. Thomas H.,
1528 Cherry St.

Spencer, Miss Pauline W.,
3421 Race St.

Spiegle, Dr. Grace E.,
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Stewart, Mr. Henry C.,
842 North 20th St.

Story, Mrs. Henry Newman,
1533 Poplar St.

Sweeny, Mrs. Frances D.,
1318 Spruce St.

Taylor, Mrs. Charles F.,
1932 North 13th St.

Taylor, Mr. Charles M., Jr.,
"The Clinton,"
10th and Clinton Sts.

Taylor, Mr. Lewis H., Jr.
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Tenbrook, Mrs. Wm. H.,
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3634 Chestnut St.

Thomas, Mr. George C.,
206 W. Washington Square.

Thomas, Miss Mary S.,
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Thompson, Mr. Edwin Stanley,
Wissinoming Hall,
Mt. Airy, Phila.

Thompson, Mr. Samuel Swayne,
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Thompson, Miss Sara H.,
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Camden, N. J.

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Toothaker, Mr. Chas. R.,
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34th bel. Spruce St.

Tower, Hon. Charlemagne, Jr.,
228 South 7th St.

Tower, Mr. Walter S.,
The Dormitories,
Univ. of Penna., Phila.

Townsend, Mr. David,
625 Witherspoon Bldg.

Trask, Mr. Harry M.,
1328 Arch St.

Treat, Miss Blanche E.,
170 Manheim St.,
Germantown, Phila.

Troth, Mr. Henry,
4037 Locust St.

Tryon, Miss Adeline S.,
1931 Race St.

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Turner, Very Rev. James P.,
225 North 18th St.

Tuxbury, Miss Helen,
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36th and Chestnut Sts.

Twining, Miss Edith J.,
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3638 Chestnut St.

Van Tine, Mrs. J. Lewis,
1706 Girard Ave.

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Vauclain, Mrs. Samuel M.,
Rosemont, Pa.

Vaux, Mr. Geo., Jr. (life mem.),
404 Girard Trust Bldg.

Vollmer, Mr. Adrien Winston,
504 Girard Trust Bldg.

Walker, Mr. Hugh Sidwell,
Land Title Bldg.,
Broad & Chestnut Sts.

Wallem, Mr. J. Nordahl,
122 South 2d St.

Walsh, Miss Inez E.,
1821 Wallace St.

Walter, Mrs. J. Horace,
2201 Venango St.,
Tioga, Phila.

Walter, Miss Naomi,
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Wanamaker, Mr. Alfred L.,
804 Land Title Bldg.

Wardle, Mrs. E. L.,
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Ware, Miss Anna C.,
Salem, N. J.

Watkins, Miss Elizabeth,
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Weimer, Mr. Albert B.,
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Weimer, Mrs. John S.,
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Weinrich, Mr. Wm., Jr.,
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Weistling, Mr. Edgar,
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Welles, Mr. Chas. S.,
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526 Drexel Bldg.

Williams, Mrs. Ellis D.,
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Williams, Mr. Henry S.,
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Williams, Dr. Talcott,
916 Pine St.

Willits, Mrs. Joseph B.,
507 North 6th St.

Wilson, Prof. W. P.,
Phila. Commercial Museums,

Wise, Miss Anne C.,
2023 Mt. Vernon St.

Wistar, Dr. Thomas (life mem.),
409 Chestnut St.

Wister, Mrs. Jones,
1819 Walnut St.

Wolf, Mrs. Laura T.,
622 North 7th St.

Wood, Miss Helen Biddle,
1016 Spruce St.

Wood, Mrs. Randolph,
1900 Chestnut St.

Wood, Mr. Stuart,
1620 Locust St.

Wood, Mr. Walter,
1620 Locust St.

Wood, Mr. Wm. E.,
1933 Vine St.

Woodall, Mr. John,
2015 Arch St.

Woodbridge, Mr. J. Edwards,
1401 Potter St.,
Chester, Pa.

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Wright, Miss Helen J.,
1934 Arch St.

Wright, Miss Mary,
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Yard, Mrs. Benjamin H.,
1318 Spring Garden St.

Yarnall, Miss Anna,
1227 Spruce St.

Yarnall, Mr. David G.,
1028 Race St.

Yarnall, Mr. Ellis H.,
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Yost, Miss Irene,
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